Agricultural Experiment Station

of the

University of Kentucky

FIFTY-EIGHTH ANNUAL REPORT

Report of the Director
for the year 1945

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(Footnotes on following page.)

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[3] Resigned June 30, 1945
[4] Resigned September 30, 1945
[5] Resigned July 31, 1945
[6] Resigned October 10, 1945

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[8] Resigned September 11, 1945
[9] Resigned October 31, 1945
[10] Deceased, November 12, 1945
[11] Emeritus October 1, 1945
[12] Resigned April 11, 1945

LETTER OF TRANSMITTAL

To His Excellency, Hon. Simeon S. Willis, Governor of Kentucky:

Sir: In accordance with an act of Congress, approved March 2, 1887, entitled, "An act to establish Agricultural Experiment Stations, in connection with the Agricultural Colleges established in the several states under the provisions of an act approved July 2, 1862, and under the acts supplementary thereto," and of the act of the Legislature of the State of Kentucky, approved February 20, 1888, entitled, "An act to accept the provisions of an act passed by the Congress of the United States, approved March 2, 1887, for the establishment and maintenance of Agricultural Experiment Stations in connection with Agricultural Colleges established by the several states and territories under the act of Congress approved July 2, 1862," I herewith submit the fifty-eighth annual report of the Kentucky Agricultural Experiment Station.

Very respectfully,

THOMAS P. COOPER, Director.

ANNUAL REPORT
of the
DIRECTOR OF THE KENTUCKY AGRICULTURAL EXPERIMEMT STATION
For the Year 1945

RESEARCH IN AGRICULTURE during the past year has been handicapped by continued shortages of trained personnel, materials, and equipment for carrying on scientific investigation. Nevertheless, the work of the Kentucky Agricultural Experiment Station has gone forward along almost all lines, and an important list of new findings has been added to the sum of established facts pertaining to agriculture in all its many ramifications. In addition to their regular duties in the investigational work of the institution, staff members during the year spent much time gathering special data and presenting information and reports needed in carrying on various parts of the war program.

Special mention should be made of the cooperative relations with the Tennessee Valley Authority. During 1945 the TVA furnished either funds or materials, or both, for investigations made by the Kentucky Agricultural Experiment Station along the following lines: studies on the residual effects of phosphates; tests of fused phosphates; tests of the effects of nitrogen applications on seed production of grasses; tests of the response of corn to applications of nitrogen, phosphorus, and potassium, and to fertilizer placement; tests on topdressing of pastures and on effect of method of applying phosphate for pasture production and composition of the herbage.

In the following sections of this report brief accounts are given of some of the important investigations carried on during the year.

[*See "Index to Subject Headings," pages 66, 67, and 68.*]

Farm-land values in Kentucky.— Farm land prices continued to rise in 1945 although not so rapidly as during the few preceding years. Of the years since 1941, the greatest increase was in 1944, averaging 15 percent. During the period 1941-45 farm land prices increased an average of 10 percent per year in the four representative agricultural counties (Bourbon, Shelby, Daviess, and Simpson) in which intensive studies in land values were made. In general, land selling at less than $50 per acre in 1941 had by the end of 1945 increased by about two-thirds, and land selling at $50 or more per acre had increased by slightly above one-third of the 1941 valuation.

Factors tending toward higher land values in 1945 were four years

of high farm production at favorable prices, a further increase in cash savings, abundant credit at low interest, and demand for farms particularly by returning veterans and war-plant workers. Other factors, on the other hand, tended to keep prices down. These included decreases in prices of some farm commodities, increased production costs; anticipated decreases in farm commodity prices and incomes; more farms for sale, especially by farmers planning to retire; and a cautious attitude of farm buyers resulting from remembrance of the land boom and decline in land values after World War I. In 1917-20 a large proportion of the land purchases in Kentucky, especially those in 1919 and 1920, were financed by small cash payments and a seller's mortgage to be paid in 1 to 3 years. In 1941-45 more than half of the land purchases were for cash, and for those on which considerable debts were assumed the repayments usually extended 10 to 20 years.

Preventing a land-price boom.— In cooperation with Experiment Stations of 11 other north-central states, a study was made of measures needed to prevent a postwar land boom. The study appeared to warrant the view that there is little in the long-run outlook to justify land prices as high as those prevailing currently, except the possibility of further general inflation or reduction in interest and capitalization rates. Land values will depend chiefly upon the net income from the land and the rate of return farm buyers are willing to accept. It was concluded that it will be possible to avoid the excesses of another land boom if certain measures are applied. Educational efforts in this direction have already been helpful. But should inflationary pressures increase, educational programs alone may not suffice. Measures indirectly affecting the land market might well be aimed at (1) curbing general inflation, (2) removing preferential treatment of capital gains in income tax regulations, (3) adjusting farm programs so they do not have an inflationary effect on the land market, and (4) providing a competent public appraisal service to assist buyers in determining the long-time earning capacity value of land. Legal controls may be needed if other efforts prove inadequate. The only safe course in view of prevailing uncertainties is to keep down mortgage debt and curb land price advances until future economic conditions are better known. Action taken along sound lines can do much to safeguard the interests of buyers, sellers, and lenders, as well as their communities and the nation.

Capital investment and income in farming.— Detailed farm management records kept during the 4-year period 1937-40, on 94 typical tobacco-livestock farms in the outer Bluegrass and the Pennyroyal type-of-farming areas of Kentucky were analyzed. During these four years the real estate value of these 94 farms averaged $8,594, and investment in livestock, machinery and equipment, feeds, seeds, and other supplies on hand averaged $2,213 per farm. Adjusted to 1945

prices, the average investment in real estate was estimated at $13,501 and the value of non-real estate investment at $3,679—a total of $17,180 per farm. The farms averaged 171 acres per farm, with 139 acres of tillable land. Labor used averaged 24.8 months per year, including work done by the farm operator and his family, hired labor, and cropper labor. The farms all produced tobacco, livestock, and livestock products. For the 4-year period the net cash income per farm averaged $1,162 per year. This was the average amount available for family living, debt payments including interest, and savings.

Farm management on grass farms.— In the study of organization and management of rolling land on which sods and grass-eating livestock are the basic elements in the farming system, data were obtained from 20 farms in 1944, averaging 197 acres of tillable land per farm. Net cash farm income averaged $5,386 per farm; gross cash income per tillable acre averaged $54.90; and cash operating expenses averaged $27.57. Net cash farm receipts ranged from $6,178 to $19,391; net cash farm operating expenses, from $1,969 to $11,121; and net cash income from $3,232 to $9,644. Cash receipts per tillable acre ranged from $37.84 to $113.66; cash operating expenses, from $12.42 to $75.69; and net cash income per tillable acre, from $18.72 to $56.45. The principal sources of cash income were orchard grass seed, hogs, beef cattle, burley tobacco, sheep, and dairy products.

Urban adjustment of rural migrants.— In a comparison of rural migrants in Lexington, Kentucky, with their urban neighbors, it was clear that many rural people adjust fully to urban ways, and reach the upper rungs of the socio-economic ladder. More of them, however, find themselves located in middle or low rent areas, and somewhat less completely adjusted to the city than their neighbors of urban birth. It is clear also that adjustment in the city is greatly influenced by the experiences and the position of the migrant during the period of his rural rearing. Adequate preparation of prospective migrants among rural youth for social and economic success in the city might well become an objective for the institutions of the rural community, and the successful absorption by cities of incoming rural migrants might well become an objective for the institutions of the urban community.

Farm income in Kentucky and the United States as a whole.— Cash receipts from the sale of farm products in Kentucky during the past 20 years have ranged from 78 million dollars in 1933 to over 400 million dollars in 1944. An index number of farm income (1935-1939=100) averaged 107 in Kentucky for the five years 1925-29, and 173 in the years 1940-44, an increase of 62 percent. Between the same periods, a similar index for the United States changed from 129 to 183, an increase of 42 percent. The difference is due, in large part, to

the importance of burley tobacco in Kentucky, prices of which have risen, relative to other farm products, for more than 30 years.

About 4 percent of the people who live on farms in the United States live on farms in Kentucky, but those who live on farms in Kentucky receive only about 2 percent of the gross agricultural income in the United States. Net realized income per farm (including value of products used at home) is about 40 percent lower for farm operators in Kentucky than in the United States as a whole.

Prices in Kentucky and the United States as a whole.— Major fluctuations in the prices of farm products have been about the same in Kentucky as in the United States as a whole, because the influences of war and depression affect them alike. Kentucky prices in general have risen somewhat relative to those in the United States, but the movements for particular products have differed considerably. From 1910 to 1919, prices of Kentucky farm products, as a group, were relatively lower than those in the United States, but from 1935 to 1940 they were relatively higher because of an upward trend in the price of burley tobacco.

Prices of corn, wheat, and hay all have averaged higher in Kentucky than in the United States as a whole during the past 35 years, although fluctuating from year to year. The price of corn averaged 10 to 12 percent above the U. S. price, with no pronounced trend upward or downward in the relationship. Prices of hay averaged 30 percent higher in Kentucky than in the United States, and were lower only in 1934 when a severe drouth in other parts of the country made hay extremely high. Drouths in Kentucky during 1916, 1930, and 1936 made hay unusually high here. Prices of wheat in Kentucky were less consistently above U. S. prices than prices of corn and hay, and showed no pronounced trend in their relationship.

Prices of beef cattle in Kentucky averaged 7 percent below those of the United States as a whole from 1910 to 1934. Since 1934 they have been more nearly equal to U. S. prices. Prices of veal calves have shown a definite tendency to rise in Kentucky, relative to those in the United States as a whole. During the last 10 years, prices of veal calves in Kentucky averaged nearly 10 percent above the U. S. prices.

Prices of hogs in Kentucky have been more uniform in their relationship to U. S. prices than have prices of most other farm products. They moved slightly upward from 1910 to 1932 and slightly downward since 1932, but the average for the past 35 years was only a little above the national average. Prices of Kentucky lambs were about equal to U. S. lamb prices from 1910 to 1915, but rose until they were 27 percent higher in 1932. Since that time Kentucky lambs have lost much of their relative price advantage. Prices of wool in Kentucky were about 25 percent above the national average from 1910 to 1917. During the past decade they were only about 18 percent above.

Dairying in Kentucky has had progressively less favorable price

relations to the rest of the country. From 1910 to 1915 butterfat prices were slightly higher in Kentucky than in the United States as a whole, but they declined until about 1935. Since 1938 there has been some improvement in this relationship. Prices of milk at wholesale followed a course similar to that of butterfat prices except that they were 25 percent above U. S. prices in the early period and 10 percent below in 1938 and 1939.

Prices of poultry products in Kentucky have maintained a relatively uniform relationship to prices in the United States as a whole, except for short-time fluctuations. From 1910 to 1940, prices of eggs in Kentucky averaged 10 to 12 percent below the national average; prices of chickens 4 to 5 percent below; and prices of turkeys, though fluctuating more than the others, 7 or 8 percent below. No long-time trends upward or downward appear in any of these relationships.

Prices of veal calves.— Price of veal calves in relation to price of butterfat was higher in Kentucky during 1937-43 than in any other state. Prices of veal calves in Kentucky since 1910 have tended to rise relative to those for the United States as a whole, while prices of butterfat in Kentucky since 1922, the first year of data, have tended to decline relative to those for the United States. Thus, in recent years, farmers in Kentucky who sold milk in the form of cream were at a greater comparative advantage in the production of veal calves than were farmers following the same type of enterprise in other states.

Veal production in the United States more than doubled from 1899 to 1944, and it increased at a greater rate than the production of all meats. Despite this increased production of veal, the price of veal calves (when deflated by the index of all agricultural prices) has averaged somewhat higher since 1926 than from 1910 to 1926, and the market demand for veal calves has increased relative to that for hogs, cattle, and chickens.

Seasonal variation in prices of Kentucky veal calves.— Prices of quality veal calves at markets serving Kentucky farmers were seasonally highest in January and February, from 10 to 15 percent above the season's average, during 1932-42. A secondary seasonal peak of prices occurred from September through December, with prices about 5 percent above the season's average. During April through July, prices were seasonally lowest, from 6 to 15 percent below the season's average. June was the lowest price month in most years. The seasonal patterns of prices from year to year, during 1932-42, were quite similar when consideration was given to changes in the general level of prices of veal calves.

Effect of methods of cooking fresh and cured pork and of canning fresh pork, on the riboflavin content.— In further studies on the vitamin content of pork, part of a national project on conservation of nutritive value of foods, analyses for riboflavin were made on different cuts of fresh and cured pork cooked different ways, and on

canned pork. Carcasses of 8 pigs were used. The pigs, raised under uniform conditions, were 6 months old at time of slaughtering, and weighed an average of 240 pounds. The cuts taken for analysis were loin, spareribs, liver, ham, and shoulder. For later analysis of cured meat, the left hams and shoulders of pigs 1-4 were salted, smoked, and stored in a cool, dry place. The cooking methods used were those approved by the Committee on Preparation Factors of the National Cooperative Meat Investigations. Riboflavin was determined by the thiochrome method of Conner and Straub.

The effect of the different methods of cooking on the riboflavin content of pork was in some respects quite different from that found for niacin and thiamine. In all cases where loss occurred, riboflavin was less affected than either of the other two vitamins. Prolonged cooking, such as is used in canning meat, seems to cause an increase in riboflavin over the amount found in the raw samples. In some cuts the percentage increase was as great as the percentage loss from other methods of cooking. In the fresh pork, greater loss occurred in the roasted and fried meats than in the boiled meats. Roast ham, loin, liver, and fried shoulder showed the highest losses.

Curing, like canning, resulted in higher values for riboflavin than were found in the fresh, raw samples. When the cured meat was cooked additional increases were effected, but the values were not so high as those found in the canned pork.

The riboflavin content of pork liver is notably high, not only compared to the other cuts of pork but also compared to the other two vitamins investigated in this project. Boiling, frying, and canning liver resulted in increases rather than losses, which again is different from the other two vitamins.

A quarter of a pound of any of the cuts of pork analyzed is generally considered an average serving. That amount raw weighs less than ¼ pound after it is cooked. In order to get a comparison of the amount of riboflavin a person consumes per average serving portion purchased, calculations were made on the riboflavin content of the cooked cuts, taking the weight as ¼ pound of raw, edible portion. On this basis, the best source of riboflavin in the muscle cuts was boiled shoulder, in an average serving portion of which there were 227 micrograms. Roast loin was the poorest source, with a content of 98 micrograms. If 2700 micrograms for men and 2200 micrograms for women are the recommended daily allowances of riboflavin, from 2.9 percent to 8.4 percent of it for men and from 3.6 to 10.3 percent of it for women could be obtained from the average serving portion of the different cuts of pork cooked in the various ways.

Liver cooked in any of the ways designated, had values so high that the average serving portion would supply 105 to 137 percent of the daily recommended allowance for men and from 129 to 168 per-

cent of that for women. Fried liver had the highest value, 3695 micrograms and roasted liver the lowest, 2841 micrograms.

Effect of roasting and reheating on the thiamine content of turkey.— As it is not unusual in home use, and is common in restaurants and hotels for turkey to be roasted, cooled, and reheated before serving, a project was undertaken to determine the effect of time of standing and of reheating on the riboflavin and thiamine content of turkey. The results for thiamine are given in this report.

Eight Broad-Breasted Bronze tom turkeys, 6½ months old, and raised on good range, with oats and corn fed separately, were used in this experiment. They were killed, dressed, wrapped in parchment paper, and put in a freezing unit. Dressed weight was 17 to 22 pounds. After 7 weeks in the freezing unit they were taken out to be roasted. They were sawed in two down the middle of the back bone and through the center of the breast bone. One-half was roasted to an internal temperature of 190° F. at a constant temperature of 275° F. Comparison of the thiamine content of roast cuts of turkey was made with the paired raw cuts. Turkeys that are well mottled with fat and roasted under these conditions do not need basting. The halves of the gizzard and liver were put inside the cavity and the turkey laid cavity-side down on the rack of the roaster, which was covered with parchment paper the size of the roaster. This was done so that there would be as little drying as possible of the muscles from the inside. Approximately three hours were required to roast the turkey half, the weight of which was about 8½ to 10½ pounds.

The skin, the halves of the liver and gizzard roasted, and outer slices of white and dark meat were analyzed immediately after roasting. After the turkey had been in the refrigerator for 24 hours, the white meat was removed from the carcass in slices and the dark meat was removed in as large pieces as possible. The total amount was divided into three portions. One portion each of dark and white meat was analyzed cold. A second portion was heated on a steam table for 20 minutes and then analyzed, and a third portion was analyzed after having been heated on the steam table for 50 minutes. The reheating periods correspond to the servings that might be obtained from a cafeteria counter at the beginning of the serving period and again towards the end of a serving period.

The skin was analyzed separately rather than by including a portion of skin with the different cuts of the light and dark meat. The outer portion of the light and dark meat was sampled while the turkey was warm.

The thiamine content of the raw dark meat averaged 261 to 340 micrograms percent calculated on dry basis, and the raw white meat 142 to 163 micrograms percent. The dark meat calculated on moist basis averaged 66.9 to 87.3 micrograms percent and the white meat 39.1 to 45.1 micrograms percent. The raw portions of dark meat next

to the skin contained more thiamine than the portions extending toward the bones. The same was true of the thiamine content of raw white meat but to a less degree.

The loss of thiamine due to roasting was greatest in the sample just underneath the skin, perhaps because of the more intense action of the oven heat. The values averaged 39.3 percent in white meat and 54.1 percent in dark meat, when calculated on dry basis.

The roasted dark meat extending further in and sampled 24 hours after roasting without reheating contained more than the sample taken immediately after roasting. When the dark meat of this portion was reheated, about the same loss of thiamine occurred as in the portion just underneath the skin. The slices of roasted white meat that had stood 24 hours and been analyzed either as cold sliced meat or reheated showed about an equal loss of thiamine, that is, from 22.5 to 24.7 percent.

The moist raw gizzard contained an average of 43.5 micrograms percent thiamine or an average of 208 micrograms percent on dry basis. The roast gizzard contained 37 percent less than the raw.

The entire amount of drippings contained from 336 to 2790 micrograms of thiamine.

Skin had almost no thiamine. Raw skin averaged 24.8 micrograms percent on moist basis or 47.4 micrograms percent on dry basis. The fat content of roast skin was considerably less than the raw skin, of course, leaving a higher percentage of muscle in roasted than in raw skin. As a result, the thiamine content of roast skin showed an average of 27 percent more thiamine than in raw skin.

Raw liver contained an average of 205 micrograms percent on moist basis, less than in dark or white meat on moist basis, but on dry basis liver averaged 676 micrograms percent. Loss due to roasting averaged 8.9 percent.

Distillers' wheat dried solubles as a protein supplement for fattening steers in drylot.— Two similar lots of 14 "U.S. Good to Choice" long yearling Hereford steers were fed in drylot for 120 days. Each steer in both lots was fed daily an average of 14.73 pounds of corn silage and 14.33 pounds of shelled corn, with free access to wheat straw, ground limestone and salt. In addition each steer in Lot 1 received daily 1.45 pounds of soybean oilmeal testing 45.6 percent crude protein, and each in Lot 2 received daily 1.80 pounds of distillers' wheat dried solubles testing 36.4 percent crude protein, produced from a mash containing 60 percent wheat, 30 percent milo, and 10 percent malt. The steers in Lot 1 gained an average of 1.89 pounds per steer per day, dressed an average 60.4 percent, and produced five "U.S. Choice" and nine "U.S. Good" carcasses. The steers in Lot 2 gained an average of 1.97 pounds per steer per day, dressed an average of 60.2 percent, and produced eight "U.S. Choice" and six "U.S. Good" carcasses. The steers in Lot 2 had slightly stronger appetites.

Digestibility by steers of a ration containing distillers' corn dried solubles.— Two 750-pound Hereford feeder steers were used in two consecutive digestion trials, each consisting of a 5-day preliminary and an 8-day collection period. During both periods the daily feed intake was held constant. The check ration consisted of alfalfa hay, ground shelled corn, and soybean oilmeal. The test ration consisted of the same amount of alfalfa hay but with ground shelled corn and distillers' corn dried solubles fed at such levels as would supply the same amounts of dry matter and crude protein as were contained in the check ration. The average digestion coefficients were as follows:

	Crude Protein	*Ether Extract*	*Crude Fiber*	*N-free Extract*
Check ration	68.9	80.7	56.3	82.6
Solubles ration	69.1	85.3	58.2	85.7

The solubles used were obtained from a mash containing 65 percent yellow corn, 23 percent rye, and 12 percent barley malt. By chemical analysis these solubles contained 31.6 percent crude protein, 9.1 percent ether extract (fat), 4.0 percent crude fiber and 40.4 percent nitrogen-free extract. The soybean oilmeal contained 40.3 percent crude protein, 6.8 percent ether extract, 6.5 percent crude fiber, and 34.1 percent nitrogen-free extract. These results supply further evidence that distillers' dried solubles are a satisfactory protein supplement for steers.

Bluegrass-molasses silage versus alfalfa-molasses silage for steers fattening in drylot.— Two similar lots of 10 good to choice western yearling Hereford feeder steers were fed in drylot for 140 days. Both lots were fed 4 pounds of "U.S. No. 2" first-cutting alfalfa hay per steer per day plus an equalized full feed of yellow shelled corn, with free access to salt, ground limestone, fresh water, and shade. Alfalfa-molasses silage made from first-cutting alfalfa in early bloom with 67 pounds of molasses per ton was fed to Lot 1 at the rate of 14.1 pounds per steer per day, and bluegrass molasses silage made from bluegrass in early bloom with 55 pounds of molasses per ton was fed to Lot 2 at the rate of 10.6 pounds per steer per day. Because of shortage of labor the bluegrass had wilted too long before being ensiled, and enough mold had developed to render it less palatable than the alfalfa silage. As a result the silage eaten by the Lot 2 steers contained 13.4 percent less total dry substance than that consumed by the steers in Lot 1. The steers in Lot 1 gained 2.07 pounds per head per day and produced 6 "U.S. Choice" and 4 "U.S. Good" carcasses. Those in Lot 2 gained 2.28 pounds per head per day and produced 5 "U.S. Choice" and 5 "U.S. Good" carcasses. These results, similar to those of previous feeding tests and digestion experiments, indicate that young bluegrass grown on fertile soil will make silage fully equal in feeding value to that made from the best alfalfa.

Alfalfa, bluegrass, and corn silages for pregnant and lactating ewes.— Four comparable lots of 10 western yearling ewes each were fed in drylot from December 8 to May 10. Each ewe in Lot 1 received 4 pounds of alfalfa hay per day, and each ewe in Lots 2, 3, and 4 was fed 1.2 pounds of alfalfa hay per day plus enough bluegrass, alfalfa, and corn silage, respectively, to supply 2.1 pounds of dry matter. The ewes in Lots 1, 2, and 3 were fed ½ pound of yellow shelled corn per head daily before lambing and 1 pound daily after lambing. The Lot 4 ewes received no corn but got 1/5 pound of soybean oilmeal per head daily because of the low protein content of the corn silage. Salt, steamed bonemeal, and fine-ground limestone were self-fed separately to all lots.

When the number, birth weight, strength at birth and gain of lambs, as well as fleece yield and gain of ewes, were all taken into consideration, the lots rated as follows, from best to poorest: alfalfa hay, bluegrass silage, alfalfa silage, and corn silage. The dry-matter intake from roughage was 15 percent higher in the hay lot than in the three silage lots. This was due to the unwillingness of the ewes in the bluegrass-silage lot to eat enough silage to reach the goal set for them. This may explain the relatively better showing of the hay, which ranked third in last year's test.

Barn-cured versus field-cured alfalfa hay for pregnant and lactating ewes.— Two comparable lots of yearling western ewes were fed in drylot from December 8 to May 10, a period of 153 days. Ewes in Lot 1 were fed 4 pounds of "U.S. No. 1" 3rd-cutting field-cured alfalfa hay per ewe per day; those in Lot 2 were fed 3½ pounds of "U.S. No. 1 extra green" 3rd-cutting alfalfa hay produced on the same field and cut on the same day as the field-cured hay, but cured on the forced-air loft hay-drier. Both lots of ewes were also fed ½ pound of shelled yellow corn per ewe before lambing and 1 pound of shelled yellow corn per ewe after lambing. In yield of fleece, gain in weight, lambing record, and lamb gains there were no significant differences between the two lots. Only 87 percent as much barn-cured hay as field-cured hay was needed to produce comparable results. Protein, fat, and fiber (all on dry basis) of the field-cured hay were 17.79, 2.60, and 24.14 percent, respectively, and of the barn-cured hay—19.68, 2.96, and 24.55 percent.

In a very carefully controlled test in ideal hay-making weather 10.7 percent less hay was obtained per acre when cured in the field, even with modern hay-making methods and equipment, than when cured on the loft hay-drier. The loss was, of course, mainly leaves.

Continuous versus rotational grazing for unweaned spring lambs.— Eight unweaned spring lambs that grazed with their dams continuously on a 3.45-acre field of bluegrass gained 11.7 percent

faster than eight comparable lambs that grazed with their dams on three adjacent 1.15-acre fields in rotation at 2-week intervals. In nine previous tests there had been a 5.5-percent advantage in favor of the rotational grazing.

Grain rations for creep-fed suckling lambs.— Suckling spring lambs creep-fed cracked yellow shelled corn to an age of 100 days ate 4 percent less grain, gained 5.6 percent faster, and reached the same market grade as did similar lambs creep-fed a mixture of 3 parts cracked yellow shelled corn and 1 part of a commercial milk substitute reputed to contain desirable growth-promoting and fattening substances not abundant in farm feeds. Less difference was noted in the average performance of the twins in the two lots than in the average performance of the single lambs. The dams of these lambs were well-fed, mottled-faced western ewes of good type and in good condition. Results were similar in a similar test in 1944.

Relation between yearling weight and performance of western ewes.— Five lots of mottled-faced western yearling ewes were selected so that those in each lot would be as nearly uniform as possible in size and condition and so that the five lots would cover, in fairly even steps, the range in weight found in such ewes as are offered for sale to Kentucky farmers. The ewes in the lightest lot were from one band and those in the four heavier lots were from a second band of ewes. The average weights of the five lots at the beginning of the breeding season, August 25, were 75, 89, 103, 119, and 144 pounds respectively. By May 10 their average weights were 89, 109, 125, 139, and 144 pounds respectively. Average lambing dates for the five lots were February 7, February 17, February 18, February 1, and March 3. Average fleece weights were 6.3, 7.1, 7.5, 8.5, and 9.1 pounds. In lamb production the next to the heaviest lot excelled, producing the earliest lambs, the most lambs, and the lambs that gained most up to 56 days of age. The heaviest ewes were a fair second except that their lambs were the latest. The two heaviest lots did especially well in producing and growing out twin lambs. The two lightest lots were definitely the poorest producers of both wool and lambs. If wool were valued at 50 cents per pound and lambs at $12 per head, the first year's production of the next to the heaviest lot would exceed that of the lightest lot by $7.10 per ewe.

Pastures for finishing late lambs.— Thirty weaned late lambs averaging 60 pounds in weight on July 13, the start of the experiment, were divided into three uniform lots and grazed without grain until slaughtered on October 5. The Lot 1 lambs were grazed on lespedeza that had been clipped twice earlier in the season to control crabgrass. Lot 2 lambs grazed soybeans made available to them in strips as needed. These beans were 12 inches tall at the start of the experiment and their pods were well filled by the end of the test. The Lot 3

lambs grazed a mixture half alfalfa and half bluegrass that had been clipped a week before the beginning of the test. The lambs on the lespedeza made the best gains but produced the poorest carcasses and the lowest average dressing percentage; those on soybeans made the lowest gains but produced the best finished carcasses and the highest dressing percentage; those on alfalfa made the second best gains, carcass yield, and carcass quality.

In a similar test last year the lambs on lespedeza produced the fastest gains, choicest carcasses and highest dressing percentages. Lespedeza in 1945 made poor growth and an unusually light seed crop.

Survival of nematode parasites of sheep on pasture.— In plots of permanent pasture contaminated with ova of *H. contortus, O. circumcincta, Trichostrongylus spp., N. filicollis, C. curticei,* and *O. columbianum* and then closed to animals until October 1, all the larvae except those of *N. filicollis* apparently were destroyed by 3½ months' exposure. A small number of *H. contortus, O. circumcincta,* and *N. filicollis* persisted on pasture for 3 months, from July 1 to October 1.

Distillers' wheat dried solubles for pigs in drylot.— In a test last year, distillers' wheat dried solubles appeared to be decidedly unpalatable to hogs. This year a test was run to determine in what proportion these solubles could be combined with soybean oilmeal (known to be very palatable to hogs) so as to be consumed in adequate yet not excessive amounts to produce efficient gains. Five lots of 63-pound pigs were used, each lot consisting of two sublots of 5 pigs each. All lots were self-fed shelled yellow corn and a mineral mixture consisting of 4 parts ground limestone and 1 part salt. Protein supplements, also self-fed, ranged from all soybean oilmeal to equal parts of soybean oilmeal and distillers' wheat dried solubles. The protein supplements fed, the average daily gains, and the feed requirements per 100 pounds gain were as follows:

	Protein Supplement	*Average Daily Gain*	*Total Feed Required per 100 Pounds Gain*
		lb	*lb*
Lot 1	Soybean oilmeal	1.63	352
Lot 2	4 parts oilmeal and 1 part solubles	1.68	345
Lot 3	3 parts oilmeal and 1 part solubles	1.57	347
Lot 4	2 parts oilmeal and 1 part solubles	1.70	356
Lot 5	1 part oilmeal and 1 part solubles	1.66	353

The dried solubles were produced from a mash of 50 percent wheat, 40 percent milo, and 10 percent malt, fermented for 36 hours.

All the rations produced very satisfactory results, with the small differences in rate and efficiency of gain being of doubtful significance. As all lots ate somewhat more protein supplement than needed to balance their rations, all the mixtures of oilmeal and dried solubles were sufficiently palatable. Evidently the distillers' wheat dried solubles used in this test were much more palatable than those used in 1944.

Distillers' corn dried solubles for fattening pigs.— In a test to determine the most efficient use of distillers' corn dried solubles as a source of protein for hogs in drylot, 6 lots of 68-pound pigs were used, each lot consisting of two sublots of 5 pigs each. All lots were self-fed No. 2 yellow shelled corn and a mineral mixture, also self-fed, of 4 parts ground limestone and 1 part salt. The rations differed only in the protein supplements used. The distillers' corn dried solubles used were below standard, having been made from a mash containing 82 percent of No. 5 corn. They contained only 26.6 percent crude protein and were rather unpalatable, possibly because the fermentation period had been 72 hours. Pigs in each lot were kept on test until they averaged about 200 pounds weight. The protein supplements used, daily gains, and total feed requirements per 100 pounds gain were as follows:

	Protein Supplement	*Average Daily Gain*	*Total Feed Required per 100 Pounds Gain*
		lb	lb
Lot 1 (91 days)	Soybean oilmeal	1.58	357
Lot 2			
First 91 days	Dried solubles	.92	417
Next 42 days	Dried solubles	1.32	331
Next 28 days[a]	Gradual change to tankage	2.62	289
Lot 3	Meat scrap, 2 parts Soybean oilmeal, 1 part Ground alfalfa hay, 1 part	1.47	365
Lot 4	Meat scrap, 2 parts Dried solubles, 1 part Ground alfalfa hay, 1 part	1.55	360
Lot 5	Soybean oilmeal, 4 parts Dried solubles, 1 part	1.48	354
Lot 6	Same as Lot 5 except that they were on alfalfa pasture	1.52	340[b]

[a] Six of the slower-gaining hogs of Lot 2.
[b] In addition to the pasturage.

The distillers' corn dried solubles used in this test were thus satisfactory as a partial substitute for soybean oilmeal on a protein-equivalent basis. Also it seemed evident from the results of Lots 3, 4, and 5

that these solubles supplied most of the essential factors furnished by alfalfa meal.

In Lot 2 the heavier hogs ate enough of the relatively unpalatable distillers' corn dried solubles to do a fair job of balancing their rations, while the younger pigs did not.

Alternate vs. continuous grazing of bluegrass pastures by dairy heifers.— During the eight seasons 1936 to 1943, the eastern half of the 11.6 acre pasture was continuously grazed during the pasture seasons by dairy heifers while the western half was divided into two fields which were grazed alternately for 1- or 2-week intervals. Since 1944 this arrangement has been reversed, the western half being grazed continuously and the eastern half grazed alternately. In the 210-day pasture season of 1945 the continuously grazed half yielded 2,495 pounds TDN per acre and the alternately grazed part 2,402 pounds per acre, as calculated from maintenance requirements for and gains made by the heifers. For the entire 10 pasture seasons, the half grazed alternately has yielded an average of 2,208 pounds TDN per acre, and the continuously grazed part 2,181 pounds TDN per acre. Data obtained during the past two seasons, however, would indicate enough difference in the productivity of the two halves of the pasture to overshadow the small difference due to the two methods of grazing.

The 10-year average yield of TDN per acre from the entire pasture (2,194 pounds) is the equivalent of the TDN in 48.7 bushels of corn, or in 2.2 tons of alfalfa hay.

Use of bacterial extract vaccine in prevention and control of mastitis.— In six dairy herds under observation in 1945, 1,028 milk samples from 239 cows were examined for the presence of mastitis streptococci. Cultures of streptococci were isolated from the positive samples and identified. Of 239 cows in three herds, 109 received 420 injections of bacterial extract vaccine. Of 104 control cows whose samples were negative at the beginning of the year, 19 (18.3 percent) became infected during the year, while out of 73 negative cows vaccinated 11 (15.1 percent) became infected.

Distillers' wheat dried solubles as a protein supplement for dairy cows.— Twenty cows in the Experiment Station herd were used in a 90-day feeding experiment comparing distillers' wheat dried solubles with soybean oilmeal as a protein supplement for heavy-milking cows. Rations used were as follows, each containing 19.5 percent protein:

	Check Ration	*Experimental Ration*
	lb	*lb*
Cracked corn, No. 2 yellow	300	300
Ground oats	100	100
Wheat bran	100	100
Soybean oilmeal	200	0
Distillers' wheat dried solubles	0	330

The "double reversal" method of experimentation was used. One group of 10 cows while receiving wheat dried solubles produced 2 percent more 4-percent-fat-corrected milk than while receiving soybean oilmeal. The other group of ten cows at the same time produced 3.9 percent more 4-percent-fat-corrected milk while receiving the soybean oilmeal rations than while receiving the wheat dried solubles. Such slight differences were probably of no significance. No significant differences were noted in weight gains or butterfat percentages during the experiment. Even though about 40 percent of the experimental ration was made up of wheat dried solubles, none of the cows showed any hesitancy in eating their full quota of 1 pound of grain to 3 pounds of 4-percent-fat-corrected milk.

Effect of age of hens on egg production, fertility, hatchability, and egg weight.— The effects of increasing age on egg production, fertility, hatchability, and egg weight in White Leghorn and Rhode Island Red hens have been studied since 1928. Egg production, fertility, and hatchability declined progressively after the first year of the hens' age, but egg weight reached a maximum in the second year and then declined slightly. Hens qualifying for several years generally declined less rapidly in egg production, fertility, and hatchability than did hens qualifying for shorter periods.

Some selective value may be attached to pullet hatchability since pullets endowed with productive longevity produced eggs that were more hatchable in the first year than did pullets which lived a shorter time.

Vegetable protein for laying pullets.— Experiments this year confirmed previous trials showing that soybean oilmeal may be used to replace animal sources of protein in the ration of laying pullets, if properly supplemented by green pasture and a source of phosphorus such as steamed bonemeal.

Crooked keel bones of chickens.— Chemical analyses and physical measurements were made of the larger bones of 20-month-old Rhode Island Red hens in laying condition, some of which had crooked and others straight keel bones. The sternum was found to be slower to calcify than the leg bones, and the keel apparently slower than the rest of the sternum. Crooked keel appeared to be a symptom of an hereditary constitutional weakness, evidently faulty metabolism rather than faulty calcification.

Osteopetrosis and an unidentified osteoma in chickens.— Osteopetrosis or marble bone was first observed in Kentucky in the fall of 1939. Both this and an unidentified osteoma became general over the state, but both have since declined and are now seldom observed in Kentucky chickens. This would indicate a sporadic rather than an epidemic condition. Evidently the feed had no influence on the de-

velopment of the abnormal bones, nor was there any evident relation between the cases of osteopetrosis and the unidentified osteoma. The length of the normal and abnormal bones in the same chicken was approximately the same but the abnormal ones were much heavier. There were small differences in the percentages of ash in the dry bones and in the percentages of calcium and phosphorus in the ash of the normal and abnormal bones.

Control of poultry lice with DDT.— DDT dusts (3 and 5 percent), 5 percent DDT in oil, and nicotine sulfate (drop method) were compared as control measures for poultry lice in 3 series of experiments. All these materials were quite effective in removing body and shaft lice from chickens, but the DDT in oil and the nicotine sulfate seemed superior to the DDT dusts in preventing reinfestation and build-up of body louse populations over a 2-months period. All of the DDT materials appeared to have enough residual effect on the necks of the birds to prevent the build-up of head louse populations.

Salmonella abortivo-equinus vaccine.— Enough vaccine was prepared to immunize 1,217 mares, on 42 farms, against *Salmonella abortivo-equinus.*

Equine abortion.— During 25 years, 1920 to 1944 (inclusive), 1,011 equine fetuses were examined in considerable detail, for the primary purpose of determining the incidence of abortion due to infections and the relative frequency of the various types of infection. The examination included gross autopsy and bacteriological examination of all, and a histopathological examination of those showing no evidence of infection. Results of examination were as follows:

	Number of Fetuses	*Percent of Total*
Negative		
No evidence of cause	385	38.0
Twins	119	11.8
Abnormal development	10	1.0
Torson of cord	12	1.2
Total negative	526	52.0
Positive		
Virus	265	26.2
Streptococcus	173	17.1
S. abortivo-equinus	22	2.2
Staphylococci	7	0.7
E. coli	10	1.0
Sh. equirulis	4	0.4
C. equi	1	0.1
Ps. pyocyaneus	1	0.1
Diphtheroid	1	0.1
Sarcina	1	0.1
Total infected	485	48.0

In nearly all cases, the history and circumstances surrounding the abortions, both sporadic cases and severe outbreaks, were well known. In all cases, the whole fetus or a substantial part thereof was examined. In some outbreaks from which only one or a few fetuses were examined, it was known that many more abortions occurred. In three outbreaks of Salmonella abortion it was known that there were 75 fetuses not presented for examination. Blood samples tested for Salmonella infection by the agglutination method, some of which were positive, were not included. Thus, the figure given for Salmonella is lower than the actual known cases.

After deducting those cases in which a positive or reasonably accurate diagnosis was made, there remained 385 cases (38 percent of the total) in which no infection was found and which showed no good evidence of the cause of abortion. This number is sufficient to warrant further study of the causes of equine abortion.

Infections of new-born foals.— During 24 years, 1921-1944, inclusive, a gross autopsy and bacteriological examination was made on 748 foals that were dead at birth or that died before weaning, most of them within 1 day to 4 weeks of age. Results of examination were as follows:

	Number of Foals	*Percent of Total*
Negative		
No evidence of cause	154	20.6
Dystocia	31	4.14
Traumatic injury	36	4.81
Abnormal development	13	1.73
Avitaminosis	4	.53
Total negative	238	31.8
Positive		
Streptococcus	195	26.1
Sh. equirulis	237	31.7
E. coli	30	4.0
S. abortivo-equinus	6	.8
S. typhi-murium	8	1.07
Corynebacterium equi	18	2.4
Total positive	494	66.1
Uncertain	16	2.1

Thus, 84 were bacteriologically negative but with definite evidence as to the cause of death, and 154 were bacteriologically negative with no explanation known as to cause of death. Many foals in addition were known to be lost but were not examined. Ten were definitely known to have avitaminosis, and others, from reports given, were undoubtedly infected. Twenty-six percent of those examined had streptococcic infection, chiefly prenatal infection, as a cause of navel ill, joint ill, and septicemia. When to this 26 percent are added the 17.1 percent

of abortions and the 18 percent sterility (among 4,000 mares examined) due to streptococcic infection, the importance of streptococci as a problem in breeding hygiene is plainly revealed.

Age of foals negative and positive to infection at time of death is given in the following tabulation:

Age at death	*Negative**	*Streptococcus Infection*	*Sh. equirulis Infection*
1 day	131	27	75
2 days	2	7	42
3 days	7	9	30
4 days	6	9	15
5 to 7 days	7	14	18
8 to 14 days	7	22	7
15 to 30 days	5	20	5
Over 30 days	21	87	45
Total	186	195	237

* Negative with no cause indicated or with dystocia.

In the foals up to and including those 7 days of age, the evidence, on examination, indicated quite clearly that the infection was prenatal. From 8 to 30 days of age, evidence of prenatal infection was not always clear-cut and for foals over 30 days of age, the evidence was, in the main, to the effect that the infection occurred post-partum.

Histopathology of noninfectious diseases.— A microscopic examination of tissues and organs from animals in which no bacterial agent or filterable virus could be demonstrated, revealed striking structural and cellular changes. Most of the tissues were from animals heavily parasitized and malnourished, others from animals that displayed general to specific symptoms of a nutritional disease.

Milder tissue changes observed were restricted to the cytoplasm of the cells in the form of albuminous and fatty degeneration, and in some there was necrosis of the cell with definite involvement of the nucleus. Many of these milder cellular changes were observed in animals before they had displayed symptoms or gross pathological lesions. In the more extreme cases there was complete loss of parenchymatous tissue with only a reticulum of connective tissue remaining.

Many of the changes in the cells of the vital organs of the animals were beyond repair to a large extent in the milder cases and completely in extreme cases. These studies confirm field observations. It has been known for years that badly undernourished, heavily parasitized animals die or fail to gain and grow normally after receiving proper medication and being placed on full feed. The body fluids (blood, urine, milk, allantoic and amniotic fluids, etc.) should be studied in the light of chemical pathology in order to determine which of the specific nutritive elements is deficient, as only by such studies can the proper means of prevention and treatment of the disease conditions in the flock or herd be carried out.

Incoordination of horses (wobbles).— During the year a study was made of microscopic sections of the brain, spinal cord, peripheral nerves and thyroid gland from 76 cases of incoordination (wobbles). In 5 of the 11 brains studied, no pathological lesions were seen. The remaining 6 represented the following changes in greater or less degree: vacuolization in both the white and gray matter, perivascular edema, scattered hemorrhage, thickening of arterial walls, gliosis, and chromatolysis of the neurons. Changes in the spinal cord included swelling of the myelin sheaths to vacuolization, swelling of axis cylinders with and without hyaline degeneration, complete absence of axis cylinders, gliosis either as a clumping of glial cells or as an increase in the network of glial fibers, hemorrhage in both white and gray matter or in the leptomeninges, shrinkage and chromatolysis of neurons, and perivascular edema in the gray commissure. Lesions of the peripheral nerves (in most cases spinal nerves) were swelling of axis cylinders, with hyaline degeneration in a few cases, swelling and degeneration of myelin sheaths. In some cases there was an extreme loss of normal architecture of the bundle of nerve fibers and replacement of the nerve tissue by connective tissue laid down in the form of masses of concentric lamellae resembling Pacinian or lamellar corpuscles. The perineurium contained hemorrhages in a few instances and areas of lymphocytic infiltration in others. Fragmentation of the tissues was present in varying degree in many of the sections. Of the 33 thyroid glands studied, 19 were classed as normal, 11 as hyperplastic, and 3 as colloid. The amount of interstitial stroma present was normal in 15, increased in 14, and decreased in 4. Vascularity of the glands had approximately the same range. The follicles varied from those regular in outline and of fairly uniform size to those extremely variable in size and irregular in outline. The amount of colloid present was normal in 13, decreased in 10, and increased in 10. In color it varied from bright red, staining with eosin and hematoxylin, to pale or blue. In many cases it appeared vacuolated and in some thin or granular. The epithelium lining the follicles was cuboidal in type in most cases but varied from quite flat squamous-like cells in the colloid glands to tall columnar epithelium in the more active hyperplastic glands.

Penicillin in oil, for horses.— Calcium penicillin suspended in oil in concentration of 100,000 units per ml was used in dosage trials to determine the blood-level response following intramuscular injection in horses. In two trials employing dosage of 300 units per pound, penicillin was present in the blood serum in measurable quantity at 4 hours following administration. In all of 5 trials in which dosage of 500 units per pound was used, penicillin remained in the blood serum in detectable quantity at the end of 6 hours following injection. Absorption of penicillin from the suspension began promptly. Thera-

peutically effective concentrations were present in the blood within 15 minutes and the maximum concentration was reached in 30 minutes following injection. The irritant properties of the preparation appeared to be of no significance and the maintenance of the effective blood level period was approximately double that obtained from saline solutions.

Agents for delaying absorption of penicillin.— The rapid absorption and elimination of penicillin by horses when the material was given in saline solutions prompted investigation of methods for delaying absorption of penicillin in aqueous solutions. Dextrose in 25- and 50-percent solutions used singly and in combination with varying concentrations of adrenalin and neosynephrin were investigated for an effect on delaying absorption. Gelatin in 15-percent solution combined with neosynephrin and adrenalin was tested. The solutions of dextrose were not effective for delaying absorption of the penicillin. Various concentrations of neosynephrin in saline solutions caused some delay of absorption but produced no significant prolongation of the detectable blood-level. The use of adrenalin with saline solutions reduced the rate of absorption and resulted in prolongation of the measurable blood-level period for approximately 30 minutes. Combining adrenalin or neosynephrin with solutions of dextrose or gelatin reduced the rate of absorption and prolonged the detectable blood-level period for 30 minutes to 1 hour. Absorption of penicillin was erratic when adrenalin was used with dextrose or gelatin and in some instances therapeutically effective concentrations of penicillin were not present in the blood. The blood-level response following use of neosynephrin with dextrose or gelatin was not significantly variable. From the results obtained in these experiments, it is concluded that the agents employed do not produce sufficient prolongation of effective blood-levels of penicillin over that obtained from straight saline solutions to recommend their use in clinical administration of the drug.

In-vitro sensitivity of equine pathogens to penicillin.— The in-vitro sensitivity of several organisms pathogenic for horses was determined by streaking agar plates containing known quantities of penicillin. Plain agar was used for *Shigella equirulis* and *Corynebacterium equi*, and blood agar for the pathogenic streptococci. The tests were read after 24 hours incubation. One strain of *Streptococcus equi* was completely inhibited by 0.01 unit of penicillin per ml of medium. Nine strains of streptococci of Lancefield group C (Ogura type A) were completely inhibited by 0.02 unit per ml, while two strains of Lancefield group C (Ogura type B) were inhibited by 0.01 unit of penicillin per ml of medium. Tests with five strains of *Shigella equirulis* showed that 2.0 to 4.0 units of penicillin per ml of medium were required to effect complete inhibition of growth. Eleven strains of

Corynebacterium equi required from 8.0 to 10.0 units of penicillin per ml for complete inhibition of growth. The results show that the sensitivity range of streptococci which infect horses is within practical therapeutic blood levels. The resistance of *Shigella equirulis* and *Corynebacterium equi* indicates that penicillin will probably be ineffective as a therapeutic agent against infections caused by these two organisms.

Penicillin dosage and blood-levels for horses.— A study was made to determine the blood-level response in horses following intramuscular injections of penicillin in saline solutions. Concentration and persistence of penicillin in the blood was ascertained in 32 dosage trials, including doses of 100, 200, 300, 500, 1,000, 2,000, and 3,000 units per pound of body weight. *Streptococcus equi* was used as the test organism. The lowest quantity of penicillin detected by the test was 0.019 unit per cc of serum.

Average persistence of detectable blood-levels resulting from the various doses was as follows in animals more than 3 or 4 months old: 100 units per pound of body weight, for about 1 hour following injection; 200 units, about 2 hours; 300 units, about 2.5 hours; 500 units, about 3 hours; 1,000 units, 3 to 4 hours. Doses in excess of 1,000 units per pound did not materially prolong the period of detectable blood level but produced higher concentrations in the blood for similar periods of time. The practical dosage for systemic treatment appears to be 300 to 500 units per pound every 2½ to 3 hours depending upon the type and severity of infection being treated. A few trials on foals indicated that the rate of elimination of penicillin is more rapid in very young foals.

Occurrence of Salmonella and paracolon bacteria.— Of 2,505 cultures examined, 2,087 were found to be *Salmonella* and were identified by antigenic analysis. Of the *Salmonella* cultures 1,618 were isolated from animals or animal food products, 459 from man, and 10 from water and sewage. Six new types were recognized as follows: *S. champaign* (XXIX:k-1,5...), *S. papuana* (VI,VII:r-e,n,z_{15}), *S. napoli* (IX,XII:1,z_{13}-e,n,x...), *S. italiana* (IX,XII:g,m,t...), *S. miami* (IX,XII: a-1,5...) and *S. pensacola* (IX,XII:g,m,t...). Also, the antigenic formulas of 7 additional new types were confirmed for other workers. Phase variation of Andrewes, hitherto recognized only in *Salmonella,* was found in a paracolon bacillus which had the formula XVI:z_{10}-e,n... . Form variation affecting the O antigens of group C *Salmonella* was discovered. This variation involved antigen VI_1 but not VI_2 and explained some of the irregularities noted in the somatic agglutinations of group C strains.

Segregation of H antigens in a culture of *S. hormaechei* due to an undescribed form of loss variation was noted. This culture dissociated

two stable loss variants, the H antigens of each of which represented a portion of the H antigens of the parent culture. The H antigens of the variants were not related to each other but all the antigens of the parent culture were possessed by both variants in combination.

The importance of improved methods of isolation and identification of *Salmonella* in the study and control of enteric infections of man and animals is continually becoming more evident. Within the past year severe outbreaks of *S. montevideo* and *S. pullorum* infections in man were traceable to the consumption of eggs which were not sufficiently cooked to destroy the organisms. *S. typhi-murium* infections in man in 3 states were traced to the same lot of infected cheese. It was learned later that a mouse was found in the previously pasteurized milk from which the cheese was made. *S. bareilly* and *S. typhi-murium* infections of chicks were traced to chicken feed which contained these organisms. The bacteria probably gained entrance to the feed through the addition of egg powder, which often contains these *Salmonella*. Reptiles have been found to carry these bacteria and at times seem to become infected with them. Snakes have been incriminated as a source of infections in domestic animals. The transfer of Salmonellosis from one species of domestic animal to another often occurs. Such transfers are evidenced by the occurrence of *S. pullorum* and *S. cholerae-suis* in diseases of cattle and *S. cholerae-suis* in infections of fowls.

Arsenic in animal nutrition.— Rats responded to arsenic supplements with increased levels of hemoglobin when fed a basal ration composed mainly of skimmilk powder adequately supplemented with iron and copper. Average hemoglobin levels (grams per 100 milliliters) for 3 groups of rats (12 in each group) after 9 weeks on the respective rations were as follows: control, 16.6; 1 ppm added arsenic, 17.1; and 5 ppm of added arsenic, 18.0. In rats fed arsenic for 9 weeks at 5 different levels of intake, the concentration of arsenic in the hair ranged from 0.6 ppm when 1 ppm of arsenic was added to the ration, to 45.4 ppm when 50 ppm of arsenic was added. In muscle of the same rats the range was from 0.5 ppm to 19.0 ppm. Rats showed no increase in concentration of hemoglobin when arsenic was added to their rations of whole milk or whole milk and glucose properly supplemented with iron and copper.

Boron in animal nutrition.— Boric acid when added to glucose solutions (25- and 50-percent concentrations) so as to furnish 500 micrograms of boron per milliliter of solution exerted no influence upon absorption of the solution by the rat. Unsuccessful attempts were made to synthesize glycogen through the use of liver slices, this being the initial step in the planned *in vitro* study of the effect of boron upon glycogen synthesis.

Boron at a level of 500 ppm of ration did not cause increased excretion of ammonia. Hence the beneficial effect of boron upon animals noted when rats were fed a low-potassium diet probably would not be attributed to increased formation of ammonia. (It is known that the ammonium ion may replace potassium in catalyzing certain enzymatic changes occurring in carbohydrate oxidation.)

Manganese in animal nutrition.— Manganese supplementation of a ration of skimmilk powder and sucrose or of whole milk and glucose, to which adequate iron and copper were added, resulted in increased synthesis of hemoglobin and enabled rats to maintain a higher level than when the rations were fortified with iron and copper only. With rats fed the dry ration the combined effect of manganese and arsenic was greater than that of either supplement alone.

The concentration of blood phosphatase in scorbutic guinea pigs usually decreased during a series of injections with mannose solution regardless of whether manganese was contained in the solution. Livers of guinea pigs injected with mannose and manganese contained no higher concentration of indophenol-reducing substances than those of animals injected with mannose only. It therefore does not appear probable that injected manganese enables guinea pigs to synthesize ascorbic acid. Efforts to produce a deficiency, while being otherwise adequate for guinea pigs, were of no avail.

Yields of hybrid and open-pollinated corn.— Ten white hybrids and 12 yellow hybrids were grown in comparison with Boone County White and Reid Yellow Dent, open-pollinated varieties, in yield tests in Fayette, Breathitt, Madison, Warren, Trigg, Caldwell, and Daviess counties. The average yield of the 24 varieties, for all locations, was 71.7 bushels per acre, although only 16 of the varieties were tested in all 7 locations. Yields in all locations were quite satisfactory, average yields being: Fayette county, 67.9 bu per acre; Breathitt county, 56.1; Madison county, 87.8; Warren county, 56.4; Trigg county, 43.9; Caldwell county, 60.2; and Daviess county, 122.8.

As averages of all tests the white hybrids averaged 74.1 bushels per acre, 10.6 bushels (16.7 percent) more than open-pollinated Boone County White; and the yellow hybrids averaged 71.2 bushels per acre, 10.7 bushels (17.7 percent) more than open-pollinated Reid Yellow Dent. The two white hybrids grown commercially in Kentucky ranked 1st (Ky 203) and 6th (Ky 72B) and averaged 10.3 bushels (16.2 percent) more per acre than Boone County White, which ranked 23d. The three yellow hybrids grown commercially in Kentucky ranked 11th (Ky 103), 12th (Ky 102), and 14th (US 13), and averaged 9.2 bushels (15.2 percent), more per acre than Reid Yellow Dent, which ranked 24th.

The more promising experimental white hybrids were Ky 405B, Ky 223, and Ky 210, which ranked high in all the individual tests, and had better root and stalk qualities than Ky 72B and Ky 203. Ky 123 and Ky 126B were among the highest yielding yellow hybrids, but produce small ears and have very weak roots and stalks. Ky 158 and Ky 137A, tested for the first time in state-wide tests, outyielded the three commercial hybrids grown and have good ear and stalk qualities.

Yield of commercial corn hybrids on different levels of fertility.— The five commercially grown Kentucky certified hybrids were grown on one series of fertility plots at Greenville to determine relative response to different levels of fertility. Ky 203 consistently outyielded Ky 72B by an average of 2 bushels per acre at all levels of fertility, there being no appreciable difference in response at different levels. In the yellows, Ky 102 outyielded US 13 and Ky 103 at all levels of fertility, the differences being slightly larger at the lower levels.

Corn improvement studies.— Nineteen white and 25 yellow inbred corn lines comprising the most promising lines from Kentucky and other experiment stations were tested, at three locations in Kentucky, in all possible single-cross combinations, to determine the lines best suited for hybrid combination. In addition, 20 established yellow lines, 30 2- and 3-generation yellow lines, 23 established white lines, and 43 2- and 3-generation white lines were tested as topcrosses. On the basis of these tests a high percentage were discarded as being unsuited for hybrid combination. Those lines showing promise of having factors for high yield and resistance to root lodging, stalk breakage, disease and insect troubles will be further selected and incorporated into hybrid combinations for more advanced testing.

Out of 100 white and 125 yellow first-generation pollinations selected in 1944 and topcrossed in 1945, over half of each were discarded on the basis of their behavior in the topcross field. The remainder will be tested for yield for further elimination before continued selfing.

Corn hybrids for silage.— Ky 102, Ky 103, Ky 72B, and Ky 203 were compared with Reid Yellow Dent, Boone County White, and Eureka, open-pollinated varieties, along with Williams' sorghum, in a silage yield test on the Experiment Station farm at Lexington. When cut at the optimum stage for ensiling, Boone County White, Eureka, and Williams' sorghum out-yielded the hybrids. However, on the dry weight basis Ky 203 and Ky 72B outyielded the open-pollinated varieties. All the hybrids produced a higher proportion of ear and leaf than the open-pollinated varieties, giving a better quality silage. In most cases the open-pollinated varieties contained a higher percentage of crude fiber and lower crude protein, fat, and nitrogen-free extract

than the hybrids. In this test Ky 72B produced a higher yield of silage than Ky 203. The stand of Ky 102 was poor, and it yielded less silage than Ky 103, although it is generally recommended as a silage corn. The sorghum produced the most silage but had a high proportion of stalk to grain and leaf tissue.

Hybrid popcorn.— Six Purdue hybrids, in commercial use in Indiana, and 2 Kentucky experimental hybrids were tested at Lexington and Owensboro in comparison with a South American open-pollinated variety. Because of drouth, yields were rather low in the Lexington test, averaging 2,993 pounds of ear corn per acre. Five Purdue hybrids averaged 3,507 pounds per acre, 75.4 percent more than the open-pollinated variety, which yielded 2,000 pounds. The highest yielding hybrid, Purdue 32, yielded twice as much as the open-pollinated variety.

Yields in the Owensboro test were exceptionally high, averaging 6,210 pounds of ear corn per acre. Six Purdue hybrids averaged 6,861 pounds per acre, 38.7 percent more than the open-pollinated variety, which yielded 4,948 pounds. The highest yielding hybrid in this test was Purdue 32, which yielded 7,287 pounds per acre. Purdue 1 ranked 2d and Purdue 38 ranked 3d in both locations. Ky 1 hybrid, a white corn, was the lowest yielding variety in both tests.

Resistance of corn to borer.— Borer populations of 32 hybrid and 2 open-pollinated field corns, planted May 1 on the Station farm at Lexington, were compared by dissecting 10 stalks in each of 2 replications in July and again in September. The first-brood borers ranged from 0 to 7 per stalk and averaged .2 to 1.45 per stalk in the different varieties of corn. In September the average number of second-generation borers ranged from 0 to 1.65 per stalk, and the total borer population averaged .6 to 2.2 borers per stalk, most varieties having more than 1 borer per stalk.

In 24 white and yellow experimental hybrid corns, planted May 2, the total borer population averaged from .5 to 2.1 borers per stalk for the various hybrids, and in the July count most of this infestation was from first-brood borer. In 78 plots of white and yellow inbred corns planted May 24 most of the borer infestation was from the second brood. Great differences were found in the number of corn borers present, a few inbreds averaging less than .5 borers per stalk and several averaging more than 4 borers per stalk. Individual stalks contained as many as 15 borers and in some plots half or more of the stalks were broken over below the ear because of borer activity.

In an attempt to see if the corn borer resistance or susceptibility exhibited by certain inbreds was carried over in the progeny, borer counts and estimates of stalk breakage were made in 28 plots of white single crosses involving the susceptible inbreds CI24 and 21 and the

resistant inbred 89. Four single crosses, each having 2 resistant parents, had low borer populations, while 6 out of 10 single crosses, each having susceptible parents, had average to high borer populations.

European corn borer parasites.— Five hundred adults of the dipterous parasite *Lydella grisescens* R. D., furnished by the Federal Bureau of Entomology and Plant Quarantine, were released in Boyle county this year in an attempt to establish that important parasite in that locality.

Over 3,000 corn borers were collected in Fayette county to check on the establishment of *Lydella grisescens* R. D., *Inareolata punctoria* Roman, and *Macrocentrus gifuensis* Ashm., colonies of which had been released in previous years. In a field close to the point of release of *Lydella grisescens,* 8 percent of the corn borers were killed by that parasite, and in another field a mile away, 4.8 percent of the borers were killed by the same parasite.

Life history of European corn borer in Kentucky.— In 1945, in spite of the cool season, corn-borer infestation on the Experiment Station farm was 2 or 3 times greater than in 1944. Some fields averaged over 2 borers per stalk and there was considerable stalk breakage. In 1944, in early planted field corn, there was a small amount of first-brood borer, some second-brood, and a very small third-brood. In 1945, however, in early planted field corn, there was at least twice as much first-brood borer as in 1944, while the amount of second brood borer was rather small. Second-brood borer was abundant in 1945 in field corn planted the latter part of May.

Overwintering larvae began pupating April 18, but moth emergence was delayed until May 24 with heavy emergence occurring between May 31 and June 13. Egg-laying began late in May, when corn planted May 1 was a foot tall, and continued heavy throughout most of June. First-brood corn borers began hatching by June 6 and many were full grown by early July. Pupation began July 16. Only 40 to 45 percent of the first-brood larvae pupated, in contrast to 97 percent in 1944.

First-generation moths emerged from July 23 to August 30, and there was a correspondingly long egg-laying period extending from July 26 to September 1. Weather conditions were fairly favorable for corn growth in the immediate vicinity of Lexington and considerable second-brood borer developed in some fields of corn.

Hardiness and yield of winter oats.— There was good snow cover during the coldest periods of the 1944-45 winter, and fall-sown oats survived exceptionally well. Only the most tender varieties were killed. Fulwin, Forkedeer, and Tennex, the most hardy varieties, survived nearly 100 percent. Four selections from the cross Fulwin x

(Lee-Victoria) survived nearly as well as these varieties. Hairy Culberson, Bicknell, Tech, Lee, and Letoria all survived better than 90 percent, while several other varieties survived 80 percent or more.

Thirty-three varieties and selections were grown in rod-row tests at Lebanon. Heavy fall growth, an unusually mild winter, early spring growth, and heavy rainfall resulted in enormous yields, averaging 117 bushels per acre. Red Rustproof, Traveler 1, Leroy, DeSoto, and Stanton strain 2 all yielded at the rate of over 140 bushels per acre, but none of these varieties will survive winters consistently in Kentucky. Five selections from the cross Fulwin x (Lee-Victoria) yielded at the rate of more than 125 bushels per acre. These selections are equally as hardy as Fulwin and, in addition, have a better straw and some rust resistance. One of these selections is now being grown in field plots for more advanced testing.

In a test of Fulwin and Winter Turf sowed at the rates of 2, 3, and 4 bushels per acre on September 1, September 15, October 1, and October 15, it was found that relatively early seeding and heavy rates of seeding when sown late gave the best results. Because of the late fall and sufficient moisture, survival on the plots sowed October 1 was only slightly less than from the earlier seedings, and plots sowed at the rates of 3 and 4 bushels per acre yielded even better than the earlier seedings. October 15 seedings survived very poorly and the yields were low. Less killing and better yields resulted from the heavier rates of seeding.

New varieties of spring oats.— Seven varieties of spring oats were grown in large plots and 18 in rod-row tests. All varieties in the plot tests averaged 57.3 bushels per acre, and in the rod-row tests 59.1 bushels per acre. In the plot tests the new varieties, Osage, Neosho, Ventura, and C.I.4140, developed at the Kansas Station, all outyielded Columbia, the recommended variety for Kentucky. In the rod-row tests only Fulton and C.I.4140 outyielded Columbia. Osage and Neosho were equal to Columbia in yield and were superior in grain quality and straw. These two varieties are being recommended for production in Kentucky when seed stocks are available. Tama, Boone, Vicland, Vikota, and Cedar, all developed from the rust- and smut-resistant Victoria-Richland hybrid, yielded satisfactorily and are suitable for production in Kentucky. The two new varieties, Clinton and Benton, developed from the D69 x Bond hybrid, yielded slightly less than Columbia but have excellent grain and straw qualities. The straw remains green after the grain is mature, so should be valuable where the crop is harvested as sheaf oats.

In yield tests of 34 red oat and 30 white oat varieties in cooperation with the U. S. Department of Agriculture, several selections showed considerable promise from the standpoint of yield, disease resistance,

and grain and straw qualities. These selections will be tested further in more comprehensive tests.

Winter barley.— In plot and rod-row tests of winter barley, Ky 1 continued to be the highest yielding, although because of a favorable season differences in yield were not great. Reno, Admire, Purdue 21, Purdue 28154, Purdue 28156, and Tennessee Winter, other winter-hardy varieties, all yielded nearly as well as Ky 1. Tucker, Iredell, and Missouri Early Beardless, all hooded varieties, shattered badly at harvest time and were low yielding.

With good fall growth and a good snow cover during the coldest periods of the 1944-45 winter, practically no winterkilling occurred. Of 55 established varieties and 44 foreign introductions by the U. S. Department of Agriculture, several showed considerable resistance to mildew, net blotch, and loose smut. These varieties are being tested further and are being used in hybridization work.

Of 193 head selections made for mildew resistance from a composite cross, 30 had excellent straw and resistance to mildew and net blotch. These are now being grown in 10-foot rows for more advanced testing.

Wheat varieties.— In plot tests of 7 varieties, Thorne and Ky R47 (Currell's) were the highest yielding. Ky NS6 (Posey's Bluestem), Fairfield, Trumbull, and Fulcaster were all similar in yield. In rod-row tests of 19 varieties the foregoing 7 varieties maintained about the same position. Nittany, Wabash, Prairie, Ashland, and Purkof were slightly lower and all similar in yield. Seven new rust-resistant selections tested for the first time for yield showed fair yielding ability but are not entirely pure for rust resistance. In a test of 30 varieties in cooperation with the U. S. Department of Agriculture, Baldrock, Clarkan, Kawvale, American Banner, Red Rock, Prairie sel., Yorkwin, N. Y. 595, and 5 selections had high yields.

From over 500 head selections made in 1944, 23 had high resistance to both leaf and stem rust. These selections, as well as several from the Purdue Station, are being grown at Lexington and in southern Kentucky for a more accurate evaluation for rust resistance.

Balbo rye for grazing.— In a comparative grazing test of Balbo, Common, and Rosen rye, each occupying .26 of an acre, 13 rams were furnished approximately 14 grazing days on the Balbo rye as compared to 6½ days for the other two varieties. The rye was sowed too late to furnish fall grazing.

Hay yields from experimental fields.— The 1945 season was decidedly favorable for hay production throughout the state. The long-established experiment fields at Campbellsville, Greenville, and Mayfield furnished outstanding examples of the amount of high-

quality hay which can be produced on adequately fertilized land. The yields were obtained by summer-seeding a mixture of grasses and legumes in a 3- or 4-year rotation of corn, wheat, and hay, the hay being harvested for 1 or 2 years. Manure is returned for corn in amounts equal to the weight of the crops, except wheat grain, removed from the plots. Fertilizers are applied in amounts equivalent to 250 pounds of 0-8-0 or 0-8-6 for each year in the rotation (1,000 pounds for the 4-year rotation).

Average acre-yield of field-cured hay for the untreated plots of the three fields was 1,500 pounds. Average increases over the untreated plots for certain treatments were: manure alone, 1,620 pounds; manure and phosphate, 3,340 pounds; manure, limestone, and phosphate, 4,510 pounds; manure, limestone, phosphate, and potash, 6,450 pounds. The quality of hay also was markedly better on the adequately fertilized plots.

Grass-hay yields.— Replicated plots of 3-year-old grasses produced hay from two cuttings at the rate of the following acre-yields: redtop, 2,635 pounds; tall oatgrass, 2,540 pounds; orchard grass, 1,620 pounds; Kentucky bluegrass, 1,175 pounds; timothy, 990 pounds; Kentucky 31 fescue, 1,605 pounds; Kentucky 42 fescue, 1,975 pounds; Kentucky 42 smooth bromegrass, 1,460 pounds; certified Nebraska smooth bromegrass, 1,230 pounds; and Canada smooth bromegrass, 675 pounds. One selection of Kentucky bluegrass produced 2,460 pounds of hay per acre.

Red clover varieties.— Kentucky 101 and 215 red clover produced 4,945 and 5,097 pounds per acre of cured hay, respectively, in two cuttings. Five lots of the Cumberland variety produced an average yield of 4,470 pounds. A new variety being developed by this Station in cooperation with the U. S. Department of Agriculture produced 5,385 pounds of hay. The Midland variety produced 4,225 pounds. A Minnesota clover produced 3,270 pounds. Differences in yield were caused largely by differences in stands that developed from competition of the small-grain nurse crop.

Lespedeza varieties.— Climax, a new early variety of Korean lespedeza, produced 1,780 pounds of cured hay per acre and Standard Korean produced 2,480 pounds. Kobe lespedeza produced 2,885 pounds.

Kentucky bluegrass seed production.— Plots in nine bluegrass fields in Fayette county fertilized March 6 with ammonium nitrate at the rate of 100 pounds per acre produced an average yield of 1,581 pounds of cured stems and leaves when the seed was mature. Plots similarly fertilized on April 13 produced 1,793 pounds and unfertilized plots produced 1,301 pounds. Average yields of seed obtained were 70, 56, and 51 pounds per acre respectively.

Two sets of plots in the same part of the county produced the highest yields of seed and three sets in another part produced the lowest yields. Average yields of clean seed from the unfertilized plots of the two groups were 111 and 10 pounds per acre respectively. Plots fertilized with ammonium nitrate in March produced 122 and 15 pounds, respectively, and plots fertilized in April produced 128 and 10 pounds, respectively. Quick soil tests indicated that the lower-producing plots were on more fertile soil than the higher-producing plots. Insects believed to be harmful to bluegrass seed production were twice as numerous on the low-producing groups of plots as on the high-producing groups.

***Control of plant bugs* Miris dolobratus *and* Amblytylus nasutus.**— In 1944 and 1945, control measures for the two plant bugs *Miris dolobratus* and *Amblytylus nasutus* were studied on 20 small plots of Kentucky bluegrass. As *Miris dolobratus,* however, was not numerous in 1944 and 1945, the results of the studies are applicable chiefly to *Amblytylus nasutus.* The control measures studied were (1) pasturing in 1944 from July until autumn, after the crop of seed had matured; (2) clipping and removing the clippings after maturing of seed in 1944, and pasturing from July until fall; (3) no treatment in 1944, but burning of the plots in February 1945; and (4) clipping after maturing of seed in 1944 (clippings not removed from plots), and pasturing from July until fall. There were 4 replications of each set of control practices and 4 checks on untreated plots. The 4 check plots in the spring of 1945 were covered heavily with matted grass and the stand of stems and seed heads was poor. Infestation by eggs of *Amblytylus nasutus* averaged 29.2 percent of the stems of these plots, and seed heads averaged 11.5 percent yield of seed. All the control measures increased the yield of seed, but only the burning treatment appreciably reduced the infestation of the stems (22 percent infestation). Best yield of seed (45 percent) was obtained where the plots were clipped after seed matured in 1944, and without removing the clippings were pastured until fall.

Miris dolobratus was not destructive in 1945, and *Amblytylus nasutus* was not generally numerous or destructive. Rearings and life history studies were continued with findings similar to those of preceding years.

Method of applying phosphates for pasture production.— In tests near Greenville and Mayfield, working different phosphate fertilizers deep into the soil before seeding permanent pasture was compared with top-dressing phosphate over a 5-year period. A total of 125 pounds P_2O_5 per acre for each phosphate was applied in each method. As an average of 5 years' results on the two pastures, superphosphate and triple superphosphate were slightly less effective where

the total amount applied was worked into the soil before seeding than where top-dressed at intervals. Average annual yields of dry matter for the 5-year period were 2,649 and 2,835 pounds, respectively, for superphosphate and 2,611 and 2,818 pounds for triple superphosphate, applied in the two methods.

Nitrogen top-dressing on orchard grass.— Four tests of top-dressing ammonium nitrate on orchard grass were conducted in four counties important in orchard grass seed production—Hardin, Henry, Oldham, and Warren. The nitrate was applied at rates of 20, 40, and 60 pounds of nitrogen per acre. Applications were made in the third week of February and the first week of April. Average acre-yield of cleaned seed on plots receiving no nitrogen was 4.3 bushels. Considering both dates of application, average acre-increases for the different rates of nitrogen were: 20 pounds N, 4.9 bushels; 40 pounds N, 7.3 bushels; 60 pounds N, 11.1 bushels; all very profitable increases in yield. Corresponding acre-yields of dry hay were 1,550 pounds on plots receiving no nitrogen, and 1,080, 1,775, and 2,380 pounds increase, respectively, for the different rates of nitrogen. As to date of application, nitrogen applied in February resulted in slightly higher yield of seed, while that applied in April resulted in significantly higher yields of hay.

Barn hay-drier.— On the Station farm at Lexington, observations were made on curing two cuttings of alfalfa and two cuttings of orchard grass containing a small amount of alfalfa. It was more difficult to cure the orchard grass than the alfalfa. The structure of the orchard-grass plant, stem, and leaves permits it to pack closer together than alfalfa, thus retarding the circulation of air and the removal of moisture. The first batch of orchard grass heated somewhat during curing. It did not spoil, but it did not have a good color. The second batch got warm and cured slowly, but the finished product had a fairly green color and was good quality hay. The alfalfa hay cured with the drier graded U. S. No. 1 green, extra leafy. Because of motor trouble, the fans were stopped 12 hours the second day after the last charge of hay was put on the drier, and as a result there was a little mold in the top layer of the hay.

Effect of crop residues on soil nitrate content.— Burley tobacco is grown in plots on the Station farm following usually 2 to 3 years of sods of various grasses and legumes. The sods are clipped at intervals and the clippings left on the land. In a recent year immediately before plowing for tobacco, the plant material on the surface of the soil was removed from foot-square areas in certain plots, airdried, and weighed. The amount ranged from 7,200 to 9,200 pounds per acre, excepting one plot where it was 5,000 pounds.

Samples of the material from each plot were ground and 2 grams mixed with 500 grams of air-dry soil (8,000 pounds in 2 million pounds of soil). These soil portions were brought to 25 percent moisture, incubated at room temperature in the laboratory, and nitrate content determined at intervals.

The residues from the different plots affected soil nitrate content somewhat differently but all greatly reduced it during the first part of the experiment. The amounts of nitrate nitrogen in the soil (pounds per 2 million pounds of soil) were as follows:

	At Start	*1 Month*	*2 Months*	*6 Months*
No residues	4	65	87	120
Residues, average	4	25	52	140

With respect to supplying nitrate nitrogen to summer crops, there was thus very little or no gain from the residues in the soil.

Effect on wheat stands of drilling fertilizer in contact with the seed.— As much as 600 pounds of fertilizer per acre drilled in contact with the seed did not reduce stand of wheat appreciably in field tests at Lexington during the fall of 1945. Several different rates of 20-percent superphosphate and 4-8-6 mixed fertilizer were tested. No fertilizer was drilled with the wheat in five of the ten drill runs of each plot. Stand data were obtained from plant counts in row sections of each plot. Final stand was only slightly reduced by the use of 900 pounds per acre of either fertilizer, but the 4-8-6 considerably delayed emergence of the wheat seedlings.

Where 1,200 or 1,500 pounds of either of the fertilizers were applied, however, the stands were definitely injured. Fifteen days after planting and about 8 days after the wheat on unfertilized plots had come up, there were 30 percent fewer plants on the plots receiving 1,500-pound rates than on the unfertilized plots. Furthermore, the plants where the fertilizer was applied at this heavy rate were appreciably smaller, one-third of them being very small or just coming through the ground, as compared with only one-tenth on the unfertilized plot.

Effect of placement and rate of application of fertilizer on yield and quality of burley tobacco.— Different methods and rates of application of fertilizer for burley tobacco were tested in 1944 on Hagerstown silt loam on a part of the Station farm at Lexington, which is less productive and more responsive to fertilizer treatments than the Maury silt loam where tobacco usually is grown. The methods of application used were row-side band, band in the plow furrow, broadcast and plowed under, disked in after plowing, drilled over the whole plot 3 inches deep, after plowing, and band 6 inches deep under row. Resulting yield differences were too small to be significant. The

fertilizer used in most of these comparisons was equal to 600 pounds of 10-5-5 fertilizer per acre. A portion of the fertilizer used, equal to 200 pounds of 5-5-5 analysis, was reserved and applied in row-side bands on all the plots except, of course, those receiving all the fertilizer at the row.

Row-side-band and plow-furrow application also were compared at twice the foregoing rates of application. Again there was no significant difference in crop response.

Yield of leaf for the 600-pound row-side-band application was 1,965 pounds an acre, valued at $44 per hundred pounds. This was 263 pounds larger than on the unfertilized plots, and the value was $3.87 per hundred pounds greater. When twice the rate of fertilizer application was used, the increase in yield was 500 pounds an acre.

In these experiments, omitting either nitrogen or potassium from the fertilizer decreased both yield and quality. Omitting only phosphorus did not decrease yield or quality significantly on this soil which contained about 2,000 pounds of total phosphorus in the acre-plow-layer and a medium amount of available phosphorus by a rapid chemical test.

Response of corn to nitrogen and potassium fertilization.— Results from 21 cooperative tests on corn, mainly to determine response to nitrogen and potassium, were obtained from 18 counties. In 16 of the tests phosphate was applied to all plots of each test in amount equal to 80 pounds P_2O_5 per acre, but in 5 tests phosphate was considered adequate in the soil and was omitted. On certain plots muriate of potash was applied at a rate of 60 pounds K_2O per acre. Ammonium nitrate at rates of 20 and 40 pounds of nitrogen per acre also was applied on certain plots. Seven of the tests were on light-colored upland soils with poor internal drainage, 5 were on creek- or river-bottom soils in eastern Kentucky subject to flooding, and 9 were on light-brown to reddish-brown upland soils with fair to good internal drainage. These soils have been cropped continuously to corn with little or no return of nitrogen and potassium by application of fertilizers. Average acre-yields of corn on the check plots of these groups, receiving neither nitrogen nor potash, were 32.9, 41.0, and 56.3 bushels, respectively. On light-colored, poorly drained soils the average increase from either nitrogen or potash fertilizer was 6 to 7 bushels per acre, and from nitrogen and potassium together, about double these figures. About the same relationship was obtained for creek- or river-bottom soils subject to flooding. On upland soils with fair to good internal drainage, little or no response to potassium was obtained. Response to nitrogen in this group was variable, depending largely upon past treatment and cropping of the soil.

Response of corn to the two rates of nitrogen fertilization was quite

variable. The 40-pound rate was about 6 bushels better than the 20-pound rate on the soils subject to flooding but was no better on the poorly drained upland soils, and but slightly better on the well-drained upland soils. As a general average of all the tests, an increase over check plots of 8.7 bushels of corn was obtained for potassium with 20 pounds of nitrogen and 11.4 bushels for potassium with 40 pounds of nitrogen.

Availability of phosphorus and potassium in soil, as measured by the Neubauer culture method.— The available phosphorus and potassium in different horizons of 5 soil types was measured by the Neubauer method and the results compared with chemical methods and with known crop response to fertilizers. The soils included members of Maury, Tyler, Pearman, and Grenada silt loams from Kentucky; Putnam silt loam from Missouri; and Barnes silty clay loam from South Dakota. Of these soils, only Maury gives no response to phosphate and Barnes gives only a slight response. The Neubauer values for phosphorus availability in the surface soils were as follows: Maury, 11.3; Tyler, 2.6; Pearman (No. 1), 1.0; Pearman (No. 2), 1.9; Grenada (virgin), 5.6; Putnam, 4.4; and Barnes, 4.4. These values increased somewhat with depth in the Maury, Pearman, and Barnes series; in all others they decreased. There was no good agreement between the Neubauer and chemical methods except that in general the two methods place the soils in about the same order of fertility. Both Putnam and Barnes surface soils gave Neubauer values of 4.4, while by the chemical method, Putnam contained 20 ppm of available phosphorus and Barnes 70. A Neubauer value of 5.0 seems to be the approximate dividing line for immediate response to phosphate fertilizer.

None of these soils, with the possible exception of Putnam, shows any marked response to potassium fertilizer. The Neubauer values for potassium in the surface soils were as follows: Maury, 21; Tyler, 10; Pearman (No. 1), 8; Pearman (No. 2), 31; Grenada, 14; Putnam, 9; and Barnes, 28. These values place the soils in approximately the right order with respect to field response and replaceable potassium content except that Pearman (No. 2) soil seems much too high. It contains only slightly more replaceable potassium than Pearman (No. 1).

Loess in Kentucky.— In field work in western Kentucky in the summer of 1945, important loessial influence in the origin of upland soils was found in that part of the state in which the upland soils previously have been considered as strictly residual from the underlying sandstones, shales, and limestones. Heretofore it was generally held that soils of loessial or part-loessial origin were confined more or less to the Purchase Region, the Cumberland-Tennessee River Section, and a band of indefinite width along the Ohio river, principally in

Union, Henderson, and Daviess counties. Evidence now at hand points strongly toward important contribution of loess to origin of most upland soil types in Livingston, Crittenden, Webster, McLean, Ohio, Caldwell, Hopkins, Muhlenberg, Lyon, Trigg, and Christian counties in addition to those areas previously known to be of loessial origin.

Mechanical fractionation of soils.— In pretreatment of soil for mechanical analysis, a method was tried to avoid the usual drastic pretreatment first with strong acid and then with alkali to get good dispersion of clay. The results obtained indicate that for some soils the less drastic pretreatment may be satisfactory.

In this work, Pearman silt loam soil was leached with ammonium acetate to remove bases and most of the hydrogen ion; it was then leached with 2-percent acetic acid to remove easily soluble phosphates, and again leached with ammonium acetate. Next the soil was treated with 10-percent H_2O_2 and leached with 2-percent acetic acid to remove phosphorus released from organic matter. Then, after again saturating the soil with ammonia and washing out excess salts with 85-percent alcohol, it was dispersed in water and the sand separated by the beaker method, silt and coarse and fine clay by the centrifuge. Water used was kept at pH 7.5 to 8.0 with ammonia. That a fairly good dispersion and separation was obtained in this case is evident from the fact that the weight of each fraction agreed closely with results of mechanical analysis by the pipette method and the base exchange capacity of the different fractions was about as expected. The exchange capacity of these separates was as follows:

	m.e./100 g.
Sand	1.2
Silt	1.8
Coarse clay	11.4
Fine clay	32.0

Fertilizer tests on corn on overflow land.— Of three cooperative fertilizer tests in 1945 of corn on land subject to frequent overflow, two were along the Cumberland river in Lyon county, and one along the Ohio river in McCracken county. No fertilizer (except fertilizing materials deposited by flood waters) had ever been applied to the soil of the test areas. Corn has been grown almost continuously. By chemical tests the soil of these particular areas was found to be adequately supplied with lime, to be very high in available phosphorus, and very low in available potassium.

In the tests fertilizer was applied in amounts equal to 625 pounds of 0-8-8, 8-0-8, 8-8-0, and 8-8-8 mixtures. Average yield of plots in the three tests receiving no fertilizer was 54.9 bushels. Average increases for the fertilizer mixtures over unfertilized plots were respectively 0.7, 17.0, 9.2, and 20.5 bushels of ear corn per acre. Yield increases

from nitrogen and potassium were marked, but there was little increase from phosphorus.

Tests of fertilizer placement for corn.— Of six cooperative tests of fertilizer placement for corn in 1945, a favorable corn year, two were on land subject to overflow, and four on upland silt loam soils. Equal amounts of fertilizers, equivalent to 625 pounds of 8-8-8 per acre, were applied in different ways. In the six tests average acre-yield of ear corn on unfertilized check plots was 49.8 bushels, indicating that the tests were on soils yielding above the average for the state. Significant increases for fertilizer were obtained in five of the six tests. Average acre-increases over unfertilized plots, for the different placements, were: all broadcast and plowed under, 20.2 bushels; 500 pounds broadcast and plowed under, with 125 pounds at the row, 17.0 bushels; 500 pounds in furrow bands, with 125 pounds at the row, 20.1 bushels; all at the row, 14.6 bushels; all broadcast and disked in after plowing, 11.3 bushels. Response to deep application of a relatively large amount of fertilizer thus was considerably better than surface or near-surface application.

In six similar tests in 1944 the general trend of results was the same as this year, although average increases for fertilizer were low in 1944 because of drouth prevailing during June and July.

Absorption of phosphorus by wheat plants growing in the greenhouse.— A study was made of the effect of widely differing phosphate applications on growth and phosphorus content of wheat plants in the greenhouse on Pearman silt loam soil from check plots at the Campbellsville soil experiment field. Phosphorus applications at the rate of 10, 20, 35, 50, 100, 250, 500, 1,000, and 2,000 pounds of P_2O_5 per acre were used. Each increment of phosphorus caused an increase in growth and phosphorus content. Yield of wheat tops was increased six times by the increase in phosphate application, from 7.4 grams without phosphate to 44.7 grams per three years, the greatest increase in growth occurring as a result of applications between 35 and 250 pounds of P_2O_5 per acre. Phosphorus content was increased over 7½ times, or from .093 percent without phosphate to .72 percent, the most rapid rate of increase coming from increments of phosphate below 100 pounds; above this amount, the rate of increase was much slower but almost directly proportional to rate of application.

Response of burley tobacco to increasing rates of application of ammonium nitrate.— On plots of burley tobacco on the Station farm in 1945, ammonium nitrate was applied at rates of 50, 100, 150, and 200 pounds of nitrogen per acre. Increased acre-yields of leaf over plots receiving no nitrogen were respectively 500, 740, 935, and 840 pounds. Value per 100 pounds was increased very slightly by the 50-

and 100-pound applications but decreased somewhat by the 150- and 200-pound applications.

Control of wireworm injury.— Larvae of the elaterid, *Conoderus lividus,* fairly numerous in central Kentucky, injure young tobacco to some extent as well as other field and truck crops. Partial rearings of this wireworm began in 1936. From July 1 to July 7, 1944, adults were collected and a study of the life history was begun. Eggs were laid July 3 to August 1 and the adults were all dead by August 14. Larvae from these eggs lived over winter, and 40 percent matured and pupated in the spring and summer of 1945. Larvae that did not mature in 1945 became more or less inactive at the beginning of cold weather. Adults emerged from the pupae June 6 to July 30, 1945. The period from egg to adult stage for 68 complete rearings ranged from 334 to 395 days with an average of 361 days.

Reared adults in 1945 laid eggs from June 29 to September 12, but very few after August 20. All of these adults were dead by September 18, 1945. Larvae from several hundred eggs were only partly developed by late November, 1945.

Control of green June beetle larvae.— Lead arsenate was applied on Kentucky bluegrass sod in the spring of 1943 in amounts of ½, 1, and 2 pounds to 100 square feet to determine the effectiveness of the poison for one or more seasons. There were 6 replications of each treatment and 6 checks or untreated plots. The treatments were fairly effective, through the third year. The ½-pound treatment killed an average of 62 percent, the 1-pound treatment an average of 79 percent, and the 2-pound treatment 86 percent of the grubs.

DDT (dichloro-diphenyl-trichloroethane) was used in the spring of 1945 in a tobacco bed to test its control of green June beetle larvae. It was applied in amounts of 20, 40, and 60 pounds actual DDT per acre; with 4 replications of each treatment and 4 checks or untreated plots. The DDT contained in a powdered material was stirred into water and was applied to the surface of the soil with a sprinkling can. The 20-pound application killed 65 percent of the grubs, the 40-pound application 57 percent, and the 60-pound application 63 percent. These percentages were too low for effective control. There was no apparent injury to the tobacco plants.

Fusarium-wilt-resistant burley.— Ky 33 is resistant to fusarium wilt and black root rot. Ky 34 is resistant to both these diseases and also to mosaic. Neither variety is entirely satisfactory in plant characters. The F_2 generation of a cross between these fusarium-wilt-resistant varieties proved to be resistant to wilt, and some plants had excellent plant characters. Selections are being made for plants of good growth characters and resistance to the three diseases. F_3 hybrids

between Barnett, Ky 33, and Ky 34 are showing a high degree of resistance to fusarium wilt, excellent plant characters, and resistance to mosaic.

Overwintering of* Salmonella typhi murium *in soil and on roots.— In connection with the study of the overwintering of tobacco bacterial pathogens on the roots of crop plants, it was desired to see whether an animal pathogen capable of living on the roots of wheat experimentally would also live through the winter in soil or on roots out of doors. *Salmonella typhi murium* was recovered at two-week intervals between November 2, 1944 and April 12, 1945 from soil inoculated October 19, 1944, and from the surface of the roots of wheat growing in this soil, but was not recovered after April 26, 1945.

Tobacco streak.— The streak virus was transferred to tobacco from 10 of 100 sweet clover plants collected May 15, 1945, from roadsides in Harrison county, and from 1 of 4 plants collected on the Experiment Station farm. Transfers were made by rubbing juice of crushed leaves onto carborundum-dusted leaves. These results leave no doubt that sweet clover is a natural host of the virus. The virus was transmitted to about 70 selections and varieties of tobacco and to several other species of *Nicotiana* in an attempt to find a resistant variety. What appeared to be slight differences in resistance were observed. Sweet clover in fence rows, roadsides, and in the immediate vicinity of twelve tobacco fields was dusted six times with 5-percent DDT dust in an attempt to destroy the insects responsible for spread of the virus. Counts were made in neighboring undusted fields for comparison. While there appeared to be some reduction in the amount of infection, the results were probably not significant.

Pathogenicity of the frogeye fungus from tobacco and other plants.— Studies were continued on isolants of Cercospora from 32 species of plants. Infection occurred and the fungus fruited on tobacco when it was inoculated with the fungus from tobacco, lupine, petunia, and pokeweed, but no infection occurred following inoculation with the fungus from 11 other species. On beans, infection and sporulation occurred with isolants of the fungus from 27 other species. Similar results were obtained on beet, petunia, pansy, cabbage, and cantaloupe, where infections occurred with the fungus from 6, 8, 9, 12, and 6 other species, respectively.

Tobacco plant-bed temperatures.— Continuous records were made of soil and air temperatures in and outside of a tobacco bed between April 17 and June 1, 1945. The principal effect of the cotton cover, so far as temperature was concerned, was to raise the air temperature during the day. The cotton seemed to have no effect on the air temperature of the bed at night.

Brown root rot of burley tobacco.— During the first part of the 1945 season burley tobacco plants in many of the plots on the Station farm at Lexington and on the Campbellsville soil experiment field were greatly injured by brown root rot. Most of these plants recovered and made fair to good growth later in the season, but yield and quality of the leaf were reduced considerably on some of these plots. The cool, wet spring probably accounted for the prevalence and severity of the disease. The plots in question had for the past 3 to 6 years been in different combinations of orchard grass, timothy, bluegrass or redtop, and red clover, alfalfa, Korean lespedeza, or white clover. The sod-crop growth on these plots had been clipped and left on the land and the available fertility level was good to high in many of the plots. Extent and severity of the disease did not appear to be associated with any particular grass or grass-legume combination or with available fertility level.

Brown root rot was absent, or present to only a slight extent, in tobacco on fertile plots in a field which had been in bluegrass-white clover for over 40 years, or in tobacco grown in a two-year rotation, or in tobacco grown continuously.

Black root rot of tobacco.— Because of the exceptionally cool, wet spring and early summer, black root rot was unusually prevalent and injurious to susceptible varieties of burley in 1945. The resistant varieties Ky 16 and Ky 41A were retarded slightly in the black-root-rot plot at the Station but made a good yield. In comparison, the susceptible varieties made very little growth throughout the summer. Several new varieties of burley resistant to mosaic (NN) and bred for a higher degree of resistance to black root rot than Ky 16 proved to be from 2 to 3 weeks earlier than Ky 16 in the black-root-rot plot and about 1 week earlier in land free from the black-root-rot fungus. Ky 120 and Ky 134, varieties of dark fire-cured tobacco that have shown considerable resistance to black root rot in the past, did not prove sufficiently resistant in 1945 to warrant being considered satisfactory root-rot-resistant varieties.

Breeding for mosaic resistance.— Ambalema, a mosaic-resistant tobacco from Colombia, South America, has been used, since 1934, as a source of mosaic resistance in breeding studies with both burley and dark tobaccos. So far no satisfactory variety of either burley or dark tobacco carrying the Ambalema factor for mosaic resistance has been developed at this Station. The varieties have been undesirable from two standpoints—undesirable growth characteristics and a tendency to wilt and scald in hot weather. In contrast, the N factor for mosaic resistance from *Nicotiana glutinosa* has been introduced into several burley varieties that are satisfactory. Also, it has been introduced into several varieties of dark fire-cured tobacco and into One

Sucker. Three of these varieties, Ky 150, Ky 151, and Ky 160, are being grown successfully by farmers.

Priming burley tobacco.— Priming experiments were expanded to obtain more complete records of labor involved, to compare results with different varieties of tobacco raised on different farms, and to compare returns from priming with those from stalk-cutting at different stages of maturity. Results were obtained from three farms, all in Fayette county.

On each farm highest returns for unprimed stalk-cut tobacco were from plots cut 11 to 20 days later than the normal cutting time. The extra return averaged $62 an acre. Future experiments will determine whether this was due to the weather being unusually favorable for preserving the bottom leaves. Average return from cutting 10 to 18 days before the normal time was $161 an acre less than the returns from cutting at the normal time.

The average time required for priming leaves, picking them up, hauling to the barn, stringing on stick, hanging on the rails, taking down and bulking, taking off the stick and tying into hands, pressing, and rebulking of the tobacco from the experimental plots primed once was 87 hours per acre. (In previous studies of priming whole fields the average was 59 hours per acre.) For handling stalk-cut tobacco from cutting through stripping, an average of 16 hours per acre less time was required on the primed plants than on the unprimed. The net time requirement for priming once was therefore 71 hours per acre. When the tobacco was primed twice, an average of 126 hours per acre more time was required for the whole operation from beginning of priming to the end of stripping than in the case of the unprimed tobacco.

The average acre-value of tobacco from the plots primed once was $107 greater than that of the unprimed tobacco cut at the normal time, which amounted to a return of $1.51 an hour for the actual net labor involved. Part of this extra return was due to the saving of tobacco which would otherwise have been lost and part to the increase in value which occurred during the extra 4 to 7 days which this tobacco remained in the field without loss at the base.

The average acre-value of the tobacco from the plots primed twice was $181 greater than that of the unprimed plot cut at the normal time and $119 greater than that of the unprimed plot cut at the same time the twice-primed plants were cut. This amounted to an average return of $1.43 per hour for the priming labor compared to the normal cutting time, or $0.90 compared to the unprimed plot cut at the same time as the twice-primed plot.

Curing burley tobacco by forced circulation.— In a study of curing burley tobacco by forced circulation of air, the chief difficulty

has been to obtain a satisfactory distribution of air within the barn. This year the structural principles of a barn were worked out, which it is believed will overcome this difficulty. The barn will contain hollow rails to support the tobacco and distribute conditioned air. Air from a warm air furnace is forced by a motor-driven fan through a main duct to a centrally located hollow partition to which one end of each hollow rail is connected. Each rail contains a number of orifices through which air is delivered in small quantities but at numerous locations. A return duct and an outside air duct are connected to the fan and furnace in a manner such that the required proportions of outside air and recirculated air may be supplied to the barn. By thus maintaining proper air conditions at all times, it is expected that cured tobacco of high quality will be obtained in the shortest possible time, that the barn can be used twice during one season, and that it will hold more than a normal amount of tobacco. This being the case, the barn can be less than half the size usually required for a given crop, thereby offsetting to some extent the cost of the equipment.

Germination of tobacco seed.— Chemical analyses for moisture, ash, boron, calcium, magnesium, and phosphorus were made on 25 samples of tobacco seed of different degrees of germinability. No relation could be found between the results of these analyses and germination percentage of the seed.

Nutritional value of tobacco seed.— During the year an investigation was completed regarding the nutritive properties of tobacco seed, both the oil and the protein portions. Tobacco-seed oil was found to be slightly inferior to butterfat with regard to digestibility but in paired feeding they gave equal growth. Tobacco-seed oilmeal apparently contained all the essential amino acids, in sufficient quantities, except lysine. When supplemented by this compound itself or by other proteins high in lysine content, the meal had a high biological value and supported excellent growth in white rats. In net protein value (which takes into consideration digestibility, biological value, and total protein) the meal was equal to other sources of vegetable proteins.

No unusual nutritive properties of tobacco seed were disclosed, such as would tend to offset the obvious economic disadvantage of tobacco seed for this purpose, in comparison with other sources of oil and meal.

Uses of agricultural residues.— During the year investigations were made on hemp hurds, sorghum cane bagasse, and tobacco stalks as sources of industrial cellulose. The original materials were analyzed for moisture, ash, lignin, pentosans, cellulose, and alcohol-benzene solubility; and the cellulose was analyzed for the alpha-, beta-, and gamma-cellulose fractions, ash, lignin, and pentosans. From the

data obtained, the "pure" cellulose in the original material was calculated. Chemically, all three of these raw materials were found to be good sources of cellulose, but economically the hemp hurds and sorghum cane bagasse are undoubtedly better sources than tobacco stalks.

Nicotine from green tobacco.— Nicotine content of most varieties of tobacco studied this year was significantly higher before drying than after. One *Nicotiana tabacum* variety (Pennsylvania Broadleaf, Greider strain) yielded at the rate of 206 pounds per acre of nicotine in the green leaf. Again this year, the highest yields of nicotine were from the *Nicotiana rustica* varieties Brasilia and Olson 68, at the rate of 246 and 220 pounds per acre, respectively, from the green leaf, and of 24 and 20 pounds per acre from the stalk. Two other *N. rustica* varieties of more desirable growth habit and one *N. rustica x N. tabacum* hybrid yielded nicotine at the rate of over 200 pounds per acre. One of these varieties, No. 43054, appears to have commercial possibilities.

Nicotinic acid by the oxidation of nicotine.— Separation of nicotinic acid from complex reaction mixtures containing it has best been accomplished by precipitation of the copper salt and subsequent treatment with hydrogen sulfide. A very low yield of nicotinic acid having a good melting point was obtained from electrolytic oxidation of nicotine. By oxidation of nicotine with potassium permanganate yields of 50 to 60 percent of very pure nicotinic acid were recovered.

Fordhook 242 Lima Bean.— Again this year, Fordhook 242, a new variety of large-seeded lima bean introduced by the U. S. Department of Agriculture, produced about 50 percent more than the standard varieties with which it was compared. It is a bush type, ripens early, and matures its crop over a shorter period than some of the older varieties. The beans are large, plump, and light green. It is recommended for home and commercial gardens.

Tomato varieties.— Nineteen varieties of tomatoes were grown to determine comparative yield, size, and percentage of fruit salable. Of the early varieties, Sioux, Valiant, Fordhook Hybrid, and Stokesdale were again superior to Break O'Day. Garden State, Rutgers, and Marglobe ranked high among the midseason varieties.

Sweet corn varieties.— The 16 varieties tested ranked as follows on the basis of number of ears and total weight (average of 2 plantings): Golden Grain, Silver Cross Narrow Grain, Stowell's Hybrid, Tri-State, Evergold, Goldenlast, Aristogold Bantam Evergreen, Silver Cross Evergreen, Aristogold Evergreen, Dreer's Golden Cross, Aristogold Bantam No. 2, Aristogold Bantam No. 1, Tenderdeep, Topflight, Tendermost, and Silver Cross Bantam.

Codling moth.— Emergence cages were stocked with 1,000 overwintering worms each and distributed and operated at Fulton, Paducah, Princeton, Henderson, Bowling Green, Louisville, Lexington, and Cold Spring. Second-brood emergence cages were also stocked and operated at Paducah, Princeton, and Henderson. Codling moth traps were operated at Fulton, Paducah, Princeton, Sturgis, Henderson, Louisville, Lexington, and Cold Spring. Because of a cold, wet spring codling moth activity was generally late in 1945, the main first-brood attack coming later than usual. Favorable weather for codling moth activity prevailed during much of July and August and much damage was done to many apple crops late in the season.

In a large orchard at Henderson, DDT was tested as a control for codling moth. Addition of 6 ounces of actual DDT per 100 gallons to all sprays in an "arsenate of lead, summer oil, and fixed-nicotine" program enabled the production of a crop of apples over 99 percent free of worms. On an adjoining check plot receiving the same sprays without DDT, about 10 percent of the fruit was wormy.

Plum curculio.— Jarring was done to determine the starting date and intensity of both the spring and summer brood activity. Adult curculios were collected and dissected for egg counts, and the resulting information was relayed to peach growers. The cool spring made early curculio activities erratic and drawn out. The summer brood was also spread out and later than usual. Most growers in western Kentucky were advised to use a month-before-harvest arsenical spray or dust. Control was variable but, in general, satisfactory. Because of serious arsenate of lead injury to peaches from earlier sprays, growers were urged to reduce their late arsenical sprays to the minimum to give economic curculio control. This season dusting of peach orchards, in general, produced more satisfactory results than spraying, chiefly because of the heavy arsenical injury in sprayed orchards.

Apple scab.— Spore determinations were made from leaf samples sent in regularly from Paducah, Henderson, Cold Spring, and Louisville, and from leaves collected locally at Princeton. Because of the very wet winter and early spring, the apple scab spores matured very early and in great abundance in 1945, promising a severe scab attack if the wet weather continued. Growers were urged to use a full schedule of pre-blossom scab sprays. The cool, wet weather continued through May and well into June, with the result that 1945 was one of the worst apple scab years on record. Growers who used the full spray schedule controlled scab fairly well, but much fruit was lost to the disease.

Oriental fruit moth.— Injury by oriental fruit moth was again severe in some scattered orchards in Kentucky, but twig infestation was generally not as heavy as in 1944. A test of several sprays for control

of oriental fruit moth was made in an Elberta orchard near Paducah where injury had been serious in previous years. The sprays used and percentage of fruit injured by oriental fruit moth this year were as follows: DDT spray, 4.6 percent; 14 percent fixed nicotine spray, 9.8 percent; DDT dust, 14.5 percent; oil-sulfur dust, 21.3 percent; and the unsprayed check plot, 23.6 percent. Two applications were made of each treatment, the first on July 10 and the second on July 24. The fruit was picked and records taken on August 7.

Oriental fruit moth parasites.— A total of 2,223 peach twigs injured by oriental moth were collected from 19 Kentucky orchards and sent to the Federal Oriental Moth Laboratory at Moorestown, New Jersey, where the parasites were allowed to emerge. *Macrocentrus ancylivorus* Rohwer, a species which the Experiment Station has attempted to establish in many Kentucky orchards, was recovered from 8 orchards. In one Paducah orchard where the parasite was introduced in 1943, it had so increased that it destroyed 43 percent of the oriental moth larvae in the 1945 twig collection.

Oriental fruit moth control with DDT.— In an attempt to see what control of the oriental fruit moth could be had with DDT, a large-scale experiment was set up in a young Elberta peach orchard in western Kentucky where fruit damage in recent years has run from 25 to 50 percent of the crop. Each of 5 treatments was applied to 5 plots of 6 trees each, each tree bearing about 4 bushels of peaches. Each treatment was made a month before harvest and again 2 weeks later. Counts for percentages of injured fruits were made August 7 and 8. Best control was had in the DDT spray plots (1 pound actual DDT per 100 gallons of water), where only 4.6 percent of the fruit was injured by oriental moth. DDT dust gave much poorer control, 14.5 percent of the fruit being injured. Two fixed-nicotine sprays, using 3 pounds of 14 percent material per 100 gallons, gave fairly good control, 9.8 percent of the fruit being damaged. On plots receiving 2 oil-sulfur dusts, 21.3 percent of the fruit was injured, and on plots receiving 2 sulfur sprays 23.6 percent was injured. No foliage or fruit injury resulted from any of the materials used nor did any other insect pests increase noticeably in the DDT-treated plots.

Peach pruning.— Elberta peach trees near Henderson, in their eighth growing season under different systems of pruning, yielded as follows this year:

Type of Pruning	*Number of Trees*	*Bushels per Tree, Average*	*Number of Peaches per Bushel, Average*
No pruning	2	8.10	219
Modified leader	8	7.44	191
Open center	9	6.25	176
Converted, modified to open	6	6.42	174

Fruit of the unpruned trees, though smaller than that of the pruned trees, was nevertheless of satisfactory size. To date the unpruned and lightly pruned modified-leader trees have yielded most. The unpruned trees, however, will soon need corrective pruning to prevent most of the fruiting wood in the lower portions of the trees from shading out and to prevent the trees from losing much of their vigor. The higher yields of the unpruned and lightly pruned trees, together with the fact that the trees converted after 5 or 6 years of growth from non-pruned and modified-leader pruning to the open-center system have recovered rapidly, indicates that peach growers might well do considerably less pruning than usual during the early years of the orchard after the trees have once been assisted in forming a strong crotch and framework.

Strawberry mulch.— In a commercial strawberry field in McCracken county results again favored fall mulching, and 1½ tons of straw per acre was more satisfactory than 2 tons. A large part of the mulch plots had to be discarded this year because the plants drowned out or suffered heavily from the red stele root disease in the extremely wet spring.

DDT sprays for May-beetle control.— Research in previous years had shown that pin-oak foliage can be protected from May-beetle attack by one spraying with 4 pounds of lead arsenate per 100 gallons of water, the first week in May. In tests this past season, however, a DDT spray containing 1 pound of actual DDT per 100 gallons of water gave even greater kill of May beetles and was equally harmless to young oak foliage. In one series of cage tests 97 percent of the males and 84 percent of the females of *Ph. hirticula* (Knoch) were killed in 5 days by feeding on DDT-sprayed foliage for 2 nights. In other tests DDT killed all of the males and two-thirds of the females of *Ph. hirticula,* whereas lead arsenate in comparable tests killed only 58 percent of the males and 47 percent of the females.

Species of white grubs.— A study was made of the larvae of 8 species of dung beetles most of which serve as intermediate hosts for parasites of domestic animals. The species were each described in detail and keys prepared for their identification. Species studied were *Canthon pilularius* (Linn.), *Choeridium histeroides* Web., *Pinotus carolinus* (Linn.), *Copris minutus* (Drury), *Copris tullius* Olivier, *Phanaeus vindex* McL., *Onthophagus hecate* Panz. and *Onthophagus pennsylvanicus* Harris.

Public service laboratories.— During the year a total of 27,862 specimens were examined in the several divisions of the department. Of 5,643 throat and nasal swabs cultured, 115 were positive for diphtheria and 641 positive for hemolytic streptococci. Microscopical

examinations were made on 6,657 smears for gonorrhea of which 2,225 were positive; 1,279 specimens of sputum for tuberculosis, with 354 positive; 1,674 specimens of feces were examined for intestinal parasites, of which 427 were positive for Ascaris or round worm, 241 positive for hook worm, and 282 were positive for other types of intestinal parasites; and 135 specimens for Vincent's angina infection, of which 89 were positive.

Microscopical examination for rabies was made on the brains of 190 dogs, 30 cats, 20 cattle, 5 hogs, 2 sheep, 5 horses, and 5 miscellaneous heads. Of the 257 heads examined, 149 were positive for rabies. Cultural examinations were made on 2,103 stool and urine specimens for typhoid, paratyphoid, dysentery and Salmonella organisms. *Eberthella typhosa* was isolated from 51 specimens and organisms of the Salmonella group were found in 10 cases.

Bacteriological examinations were made on 3,962 water samples and 2,716 samples of milk, cream, ice cream, and other dairy products for sanitary quality. Chemical analyses were made on 2,549 samples of milk, cream, ice cream, and other dairy products for adulteration. Seventy-five samples of milk were found to contain added water, ranging from 3 percent to 74 percent, while 57 were found to contain less than the minimum legal limit of 3.25 percent butterfat. Of 85 samples of cream collected and submitted by investigators for the War Food Administration, to determine compliance with regulations prohibiting the sale of cream containing more than 19 percent butterfat, 67 were high in fat and failed to comply with the regulation, and 7 were deficient in butterfat. Of 409 samples of milk submitted as "pasteurized milk," 42 samples were found to contain either raw milk or were under-pasteurized. Many of the samples of "pasteurized milk" showed a high plate count and the presence of coliform organisms, indicating the milk to be of poor sanitary quality, either through failure to observe proper technic in pasteurization or from subsequent contamination of the milk after leaving the pasteurization vat. Of 14 official samples of cheese submitted, 13 were found to be underpasteurized.

A total of 114 official samples of food and carbonated and still beverages and beverage concentrates were received from the Division of Food and Drugs of the State Department of Health. Of 51 beverages and beverage concentrates 9 contained benzoic acid, 11 contained saccharin as a substitute for sugar, and 7 contained monochloracetic acid which has been declared by the Federal Food and Drug Administration to be a dangerous adulterant in such beverages.

Twenty official drug samples were submitted by the Division of Food and Drugs, of which 11 were for washing and disinfectant purposes and were submitted for chemical analysis for composition and for determination of germicidal strength. Only 3 of the samples conformed to declared germicidal strength in the dilution recommended.

The Division of Sanitary Engineering of the State Department of Health submitted 76 samples of stream water for examination of sewage and industrial waste, and the Division of Game and Fish submitted 36 samples of stream water for examination for mine drainage, distillery waste, and other organic pollution harmful to fish. Thirty-nine samples of water were examined from private and semipublic supplies for excessive salt or other mineral constituents, hardness, and for methods of treatment to soften.

Bacteriological investigations were made in 27 cases of suspected food poisoning. Two samples of cheese submitted by a County Health Department were found to be contaminated with *Salmonella typhimurium* and *B. coli*. Most of the other cases investigated showed the presence of coliform organisms and other evidence of insanitary conditions conducive to spoilage.

Toxicological investigations were made on the stomach and contents and other organs and materials connected with the death of 16 persons. In several of the cases, death from drinking alcohol denatured with wood alcohol was suspected, but the bodies had been embalmed prior to autopsy, which renders impossible the detection of wood alcohol and seriously interfers with other tests.

The stomach contents and other material connected with the death of 31 animals were received for analysis for poison, 5 of which showed definite evidence of chemical poison while 3 showed indication of plant poisoning.

A total of 20,025 sterile specimen containers for submitting specimens to the laboratories were prepared and shipped to physicians, clinics, hospitals, and County Health Departments during the year.

Fertilizer control.— During the year 810 inspection samples and 23 farmers' and special samples were analyzed. Collaboration was continued with 75 participating chemists, part state and part commercial, in the analysis of a monthly check-sample. The purpose of this work was to improve accuracy of analysis in harmony with the methods of the Association of Official Agricultural Chemists.

An investigation was continued on the determination of phosphorus in fertilizer mixtures containing organic material, about 500 determinations being made in this study.

Attention was given to the determination of boron in fertilizers, as some boron is being added to fertilizers for use on alfalfa in this state. Procedure for the determination of nitrogen was shortened somewhat.

Feed control.— During the year, 1,000 inspectors' and 117 dealers' samples of feed were analyzed, and a number of miscellaneous samples examined. Many feeds were below standard. Because of the shortage

of high-quality ingredients, more low-grade materials were used, and this of course was reflected in the finished feed.

The Feed Laboratory continued collaboration with a large group of chemists, both state and commercial, in the analysis of check-samples as part of the investigational work of the Association of American Feed Control Officials. The purpose of this work was to improve the accuracy of analysis in harmony with the methods of the Association of Official Agricultural Chemists. During the year, a report was published on the investigation of fat in cooked animal feeds containing cereals.

Seed inspection.— During the year ending December 1, 1945, the seed analysts tested 6,297 samples of seed. Of this number 692 were official (or collectors') samples, 1,031 were tobacco samples, 160 hemp samples, and the remainder (4,414) were miscellaneous samples. Purity tests were made on 3,542 samples and germination tests on 5,957. Samples received were classified as follows: grasses 1,110; legumes 1,896; cereals 1,344; vegetables 56; miscellaneous 8; official 692; tobacco 1,031; and hemp 160.

Tobacco seed cleaned during the year amounted to 7,060 pounds. Germination tests were made on 939 samples representing approximately 700 lots of this commodity.

Nursery inspection.— The nursery inspector made 81 regular inspections, including 921.5 acres of nursery plants, 9,800 square feet of sweetpotato plant beds, 700,000 square feet of greenhouse plants, and 250,000 gladiolus corms in storage. During the inspection the following insects and plant diseases listed in order of frequency of occurrence were found: *Insects*—bagworm, oriental fruit moth, elm leaf beetle, strawberry crown borer, iris borer, gladiolus thrips, wooly aphis, white pine bark aphis, holly leaf miner, euonymus scale, obscure scale. Red spider was second in importance among pests found. *Diseases*—cedar rust, peony blotch, cherry leafspot, juniper twig blight, gladiolus scab, fireblight (pyracanthus), phloem necrosis, strawberry leafspot, powdery mildew (apple).

Phloem necrosis continued to kill elms in Kentucky in ever-increasing numbers, especially in street and landscape plantings. It was suggested to nurserymen that seedlings be produced from mature trees which have shown resistance to this disease. The Dutch elm disease was found in two trees in Campbell county, Kentucky, this year. Limited scouting along the Kentucky side of the Ohio river, as far west as Henderson county, by representatives from the Bureau of Entomology and Plant Quarantine revealed no further tree infections in that area, whereas the disease seems to be rather prevalent just across the river in Ohio.

Trapping for Japanese beetles in Kentucky was conducted on a larger scale than in previous years, traps being placed in the principal towns in every section of the state. No beetles were found in any of the traps. Established infestations of Japanese beetles are known to exist in every state bordering Kentucky. This fact has been brought to the attention of Kentucky nurserymen and cooperation within the nursery industry has been responsible, to a large degree, for the absence of the beetles in Kentucky.

Analyses of limestone, marl, soil, and miscellaneous materials.— During the year 140 samples of limestone and 56 samples of marl were tested for neutralizing value, and 223 samples of soil were analyzed for acidity (pH), total nitrogen, total phosphorus, and available potassium. The analyses were made by the extraction method with dilute acids, and also on most of the samples, for comparison by the "quick methods" as published by the Purdue Experiment Station and the University of Illinois. The results obtained with the quick tests were not closely in line with those obtained by the extraction method.

Analyses and appropriate chemical tests were also made on 16 samples of water and about 50 samples of miscellaneous materials.

Creamery license section.— Licenses to buy milk or cream on butterfat basis issued and in force totaled 946, of which 928 were renewals and 18 were issued to establishments beginning operation after July 1. The total included 8 creameries, 15 cheese plants, 7 condenseries, 72 milk plants and ice cream manufacturers, 25 independent operators of cream stations, and 819 cream stations under contract to creameries. Authority to test for the period ending June 30, 1946, was issued to 1,046 operators using the Babcock test. These included 880 renewal licenses, 96 licenses issued since July 1 after satisfactory examination, and 70 permits pending examination issued since July 1.

Examinations for applicants for license to test were held as follows: Bowling Green, 3; Lexington, 4; Louisville, 6; Mayfield, 4; Maysville, 3; Owensboro, 2; Princeton, 4; Somerset, 3; Walton, 1; Columbia, 4; Ashland, 2; special, 3. Of 434 applicants notified to appear for examination, 245 appeared, 214 passed, and 31 failed. Of those failed, 6 reappeared and passed on the second examination.

During the year 769 inspections, including 18,915 tests, were made. Creamery operators were graded as follows: A and B (satisfactory), 394 operators; C (unsatisfactory), 194; D (probation), 172; and E (cited to appear before the Examining Board), 9.

Of 24,665 milk and cream test bottles, cream test weights, and milk pipettes received for calibration, 29 were rejected. Items of buying equipment in use, found on inspection to be incorrect or defective and a possible cause of inaccurate weights or tests, were: 2 test scales,

46 cream test weights, 8 receiving scales, 15 platform scale weights, 9 centrifuges, 1 pair dividers, 17 thermometers, 27 pieces illegal glassware, and 5 miscellaneous pieces of equipment. These were condemned and ordered to be replaced.

The Examining Board decided 19 cases as follows: 1 revoked license was reinstated, 1 request for reinstatement is pending, 3 inactive testers on probation were dropped from the minutes, 1 tester was removed from probation on satisfactory inspection, 3 were continued on probation with a decision to be based on future inspections, and due to unsatisfactory testing and violation of regulations 10 licenses were revoked.

Receipts for the year were $8,646.09; and expenditures $10,694.15 as itemized:

Salaries and labor	$ 8,306.57
Communication service	319.93
Freight and express	17.00
Sundry and laboratory supplies	114.55
Travel	1,909.46
Miscellaneous	26.64
Total	$10,694.15

WESTERN KENTUCKY SUBSTATION

General farming.— Corn, wheat, and hay were harvested from the nonexperimental areas of the farm. Both silos were filled from the general corn acreage and the remaining corn was cribbed. Some wheat was sold and an ample supply was kept for poultry rations. Enough wheat straw was baled to supply needs of the farm for a year. Three cuttings of alfalfa and orchard grass from a 10-acre area, seeded in August 1944, made excellent yields of high-quality hay. A large part of the general acreage of the farm was in pasture grazed with dairy and beef cattle and mowed one or more times during the year.

Dairy herd.— The herd of purebred Jerseys averaged 16 milking cows during the year, and 16 heifers and calves. Daily milk production and feed consumption records were kept on each animal, and the herd was enrolled in the local Dairy Herd Improvement Association. From December 1, 1944 to December 1, 1945 the average production per cow was 6,802 pounds of milk and 367 pounds of butterfat; and income above feed cost per cow was $172.59.

Records were somewhat lower than usual because four of the best cows aborted during the year, and a larger than usual proportion of the herd was heifers and 3-year-old cows. Blood tests proved that the abortions were not due to Bang's disease, of which this herd has been free for many years.

Pasture experiments.— The unfertilized 10-acre pasture of the permanent pasture experiment supported an average of 0.31 steers per acre throughout the grazing season of 140 days and each of the 10-acre fertilized fields supported an average of 0.92 steers per acre. One of the fertilized fields has received ground rock phosphate at the rate of about 171 pounds per acre per year, the other ground limestone and 20-percent superphosphate at rates of about 294 pounds and 86 pounds respectively per acre per year. Total gains per acre in weight of the steers on the fields during the grazing period were 40, 130, and 141 pounds, respectively.

Distillers' wheat dried solubles versus soybean oilmeal for fattening steers.— Two lots of 14 yearling Hereford steers each were fed 120 days in drylot. Both lots received the same amounts of shelled corn, corn silage, and wheat straw and had access to ground limestone and salt. As a protein supplement, Lot 1 was fed distillers' wheat dried solubles and Lot 2 was fed soybean oilmeal. The distillers' solubles was fed at daily rate of 1.9 pounds per steer and the soybean oilmeal 1.5 pounds per steer, both feeds thus providing the same amount of digestible protein. Gains, dressing percentage and financial returns were practically the same in both lots, as shown in the following summary of results:

	Lot I (Distillers' Solubles)	*Lot II (Soybean Oilmeal)*
Average daily gain per steer	1.97	1.89
Dressing percentage	60.20	60.40
Number of carcasses graded "Choice"	8.00	5.00
Number of carcasses graded "Good"	6.00	9.00
Average sale price per 100 pounds	$16.02	$16.03

Vegetable versus animal protein for growing pullets.— This experiment included four broods each allowed pasture when 6 weeks of age. The chicks were started on a good mash and when old enough to go on pasture (bluegrass) were given the following feeds, hopper fed:

Pen 1, yellow corn, whole wheat, and meat scrap with 2 percent salt added; and Pen 2, yellow corn, whole wheat, soybean oilmeal with 2 percent salt added, and steamed bonemeal. At maturity the pullets were housed in separate laying pens and all pens were fed a laying mash, grain, ground limestone, and liquid skimmilk. Neither in egg production nor in hatchability was there any significant difference between the two pens of pullets.

Rate of phosphate fertilization.— In a test of phosphate fertilizer on limestone land, doubling the usual application of superphosphate for the crop rotation practically doubled the crop yield increases in 1945. On plots receiving limestone, potash, and nitrogen fertilizers but no phosphate the acre-yield of corn averaged 54.8 bushels, wheat

8.7 bushels, and clover and grass hay 2,810 pounds. Superphosphate at rate of 250 pounds per acre in addition to the above basal treatment increased the yield of corn 5 bushels, wheat 13.4 bushels, and hay 725 pounds, whereas 500 pounds of superphosphate gave increases of 15.5 bushels, 17.8 bushels, and 1,300 pounds, respectively.

Top-dressings on alfalfa.— From fertilizer top-dressings (superphosphate; superphosphate and borax; and superphosphate, borax, and potassium) made in March on small plots in established alfalfa fields there was very little effect this year on growth, color, or condition of alfalfa from any of the treatments. Ample rainfall from early spring until the second cutting of hay was harvested, resulted in rank growth of alfalfa on all plots. Careful observations and measurements, made before each of the three cuttings, revealed no visible effects from the boron. In late summer, growth was slightly heavier on the plots treated with phosphate and potash.

Hybrid corn yields.— Eight white corn hybrids were tested in comparison with open-pollinated Boone County White, and 10 yellow hybrids were tested in comparison with open-pollinated Reid Yellow Dent. Each was replicated 5 times in plots of 30 hills each. Yields and rankings were as follows:

	BUSHELS PER ACRE		
	Average Yield	*Increase over Open-Pollinated*	*Decrease under Open-Pollinated*
White Corn			
Ky 223	77.9	13.1	..
Ky 210	76.9	12.1	..
Ky 203	75.1	10.3	..
Ky 407	71.8	7.0	..
Kansas 2234	71.3	6.5	..
Ky 272	71.2	6.4	..
Ky 405B	70.4	5.6	..
Boone County White	64.8	...	..
Ky 72B	62.8	...	2.0
Yellow Corn			
Ky 137A	79.7	12.7	..
Ky 117	79.1	12.1	..
Ohio 3089	74.8	7.8	..
Ky 158	71.7	4.7	..
Ky 123	69.1	2.1	..
Reid Yellow Dent	67.0	...	..
Ky 120	66.8	...	.2
U.S. 13	65.6	...	1.4
Ky 102	64.7	...	2.3
Ky 103	64.0	...	3.0
Ky 122	63.8	...	3.2

Ky 223, Ky 210, Ky 203, Ky 137A, and Ky 117 made outstanding yields of 75 to 80 bushels per acre, 10 to 13 bushels per acre more than open-pollinated varieties. Ky 137A made the highest yield in the test

and produced very attractive ears. Kansas 2234 and Ky 117 were hard to husk.

All hybrids which yielded less than the open-pollinated varieties this year yielded more than such varieties in past years. The open-pollinated varieties made exceptionally high yields this year, a year of heavy rainfall. They are affected more by drouth than most of the hybrids, as indicated in the 1944 results.

Wheat varieties.— Fairfield, a late-maturing kind, was added to the test this year. Among the 8 varieties compared there was only a small difference in yield. Yields, averages of all replications, were as follows:

	Bushels per Acre
R47	22.2
Kawvale	22.2
Nabob	25.2
Fulcaster	24.2
Trumbull	21.9
Thorne	23.4
Ky. N. S. 6	22.2
Fairfield	21.0

Grass varieties.— Twelve different grasses were grown in a grass species test. Growth was mowed twice and clippings were weighed green, just after cutting. Tall oat grass, Kentucky 31 fescue, orchard grass, and red top produced highest yields. The first year yield of Alta fescue indicates that this species is quite promising. Brome grass and Kentucky bluegrass produced good sods. Stands of timothy, reed canary, and Canada bluegrass were not satisfactory. Chewing's fescue produced a good sod but growth was very short.

Apple orchard cover crops.— In a 19-year-old orchard, apples on a plot on which soybeans are grown as a summer cover crop and rye and vetch as a winter cover, yielded 5 bushels of picked fruit per tree, and trees of same varieties in lespedeza sod averaged 4 bushels per tree. This was contrary to results of the last several years, when yields from the lespedeza sod plots were higher. Heavy rainfall this year may account for the change. In dry seasons fruit is small on the cultivated plot. Yields of picked fruit, by varieties, averaged as follows: Stayman, 4.8 bushels; Delicious, 5.0 bushels; Winesap, 1.0 bushel; Yellow Transparent, 7.2 bushels. Yellow Transparent yielded heavily on all trees in the cultivated plot, but in sod plots where soil is more irregular some trees are bearing only in alternate years. Set of fruit was light on all varieties except Yellow Transparent and was especially light on Winesap this year. Even though a total of 12 sprays were applied from early spring through July, codling moth injury was severe and there was some scab and quince rust.

Apple varieties.— In the young variety trial planting made in 1939 the following varieties bore heavy crops: Anoka, Holland, Lodi, and Williams' Early Red. Light-to-medium crops were borne on Yellow Transparent, Red Bird (Crimson Beauty), Starr, Polly Eades, Jonared, Starking, Golden Delicious, Gallia Beauty, and Paducah.

In picking on June 11 four varieties yielded the following number of apples per 45-pound bushel: Starr, 145; Lodi, 193; Red Bird, 236; and Yellow Transparent, 257. This was the first date that Transparents could be picked and packed at a size of 2 inches and up. A week later Transparents still were the smallest; and another variety, Anoka, was also slightly larger than Transparent. All these varieties appear promising as commercial early apples with Lodi possibly in the lead because of its heavier crop and earlier, higher quality fruit.

Seventeen-year-old peach orchard.— Of 396 Elberta peach trees originally planted there are now 333 full-size, live, active trees in the orchard on the Jacob tract. In 14 years of bearing age this orchard has produced 3 full crops and 6 partial crops, and has had 5 complete crop failures. The third full crop was produced this year. The total yield this year was 1,762 bushels, or an average of 5.2 bushels per tree. Quality of the fruit was good. Differences in plot yields in the cover crop test were not sufficiently great to be significant and are largely accounted for by soil variation. Fruit size was good on all except one cultivated plot where some erosion has occurred. One row of trees which has had practically no pruning since coming into bearing averaged 6.8 bushels of peaches per tree and an adjacent row pruned each year averaged only 5.1 bushels. Fruit of the pruned row was only slightly larger this year but in dry seasons this difference has been more pronounced.

Peach varieties.— After a comparatively mild winter and scarcely any dormant fruit-bud killing, but early bloom and several freezes and frosts from early April to early May, most peach varieties came through with a heavy crop that needed thinning. Varieties that did not set a crop were Fireglow, Dixigold, Illinois K-50, and Cumberland. The first three have failed repeatedly and seem to be unadapted to Kentucky conditions, while the Cumberland is ordinarily very hardy. Some of the very new varieties and selections that looked good in 1945 were Redhaven, Erly Red Fre, Raritan Rose, F. V. 9-93, South Haven No. 20, Kalhaven, Sullivan's Early Elberta, Illinois K-56, Illinois K-40, Illinois K-63, and Illinois K-43. Other slightly older varieties that showed promise of future usefulness were Marigold, Fisher, June Elberta, Sunbeam, Golden Jubilee, Fair's Beauty, Triogem, Viceroy, Vedette, Dr. Burton, Halehaven, July Elberta, Golden Globe, Sunhigh, Goldeneast, Ideal, Hiley, July Heath (Othelle), Veteran, Gage, Midway, White Hale and Afterglow. Garden State Nectarine and a selec-

tion known as Cardinal Heath were a total loss from brown rot and are to be discarded.

Plum varieties.— The Bruce plum, a large, showy variety suitable for shipping and eating out of hand, bore another heavy crop, indicating continued adaptability to western Kentucky. Munson and America, two other varieties suitable for home use and local markets, produced another heavy crop. Gold, a variety that has not set regular crops, produced a heavy crop in 1945, but suffered serious loss from brown rot. Early Italian prune and regular Italian prune bore their first good crop in this their seventh growing year. Both varieties produced good-quality fruit suitable for cooking, canning, and eating fresh, but the yields were not heavy.

French damson in its seventh year did extra well, producing an average of ¾ bushel per tree of large, uniform, high-quality fruits; while Shropshire damson, the same age, produced only ¼ bushel per tree of medium sized, nonuniform fruits, and Blue Damson yielded only ½ gallon per tree of large, uniform fruits.

Blackberry varieties.— In a planting made in 1939, Ozark Beauty gave the highest 1945 yields, and Early Harvest was second. The fruit of Alfred was large and of high quality but the variety has lost many plants from orange rust. Eldorado had good fruit, but in this planting it includes a mixture of an unfruitful sort which makes it worthless. Boysen, Young, and Brainerd, three trailing sorts, all suffered some winter injury as well as general loss of vigor and had very poor yields. Ozark Beauty was the only upright variety that had not suffered some loss from orange rust. It is not hardy in our coldest winters and probably should not be planted farther north than western Kentucky; but its high fruit quality, vigor, and resistance to orange rust make it worth trying in areas with good air drainage where extreme winter hardiness is not required.

Strawberry varieties.— In a second-year planting, Blakemore was again the heaviest yielding, early shipping variety, with 120 crates per acre, followed by Tennessee Shipper, with 88 crates. As a medium late berry, Tennessee Beauty with 118 crates was again far ahead of Aroma, which produced only 55 crates. Tennessee Beauty produced 25 crates more in 1945 on second-year plants than it did in 1944 on first-year plants, being the only major variety to show an increase in the second fruiting year.

Plants of the McUmber Blakemore strain, received in 1939, showed their first yellows in 1944 and have shown no more since then. A yellows-resistant strain obtained from the U. S. Department of Agriculture at the same time has shown no yellows to date.

ROBINSON SUBSTATION

General farming.— Good crops of corn and hay were produced this year. Hybrid corn, Ky. 103 and Ky. 203, on 20 acres produced about 60 bushels per acre. Hay on 19 acres produced enough roughage to carry all the livestock through the winter.

Livestock and poultry.— The project of breeding up of scrub and grade cattle by the use of purebred Brown Swiss bulls was continued with satisfactory results. At the end of the year there were in the herd 7 second-generation Swiss-scrub heifers, 2 Swiss-Jersey heifers, and 2 purebred Swiss heifers. Three of the cross-bred heifers were bred to Swiss bulls. The herd as a whole consisted of 1 bull, 15 cows, and 14 heifers and calves.

Because of high price and scarcity of feeds this year, few hogs were raised. There were only 5 hogs on the farm at the close of the year.

Eight hundred baby chicks and 200 poults were hatched at Lexington and brooded at the Substation. From the chicks raised 180 were selected, banded, and kept as breeders, and the remainder sold as broilers and friers. The turkeys were Broad-Breasted Bronze, most of which were sold on the Thanksgiving market.

Fruits.— Fruit was a failure because of a late freeze in March. The regular spraying and pruning was carried on.

Vegetable versus animal protein for growing pullets.— In this experiment meat scrap as a source of protein for the growing pullets was compared with soybean oilmeal. Both broods were fed a balanced mash until ready to go on pasture (legume), when they were hopper-fed as follows: Brood 1, shelled corn, and meat scrap with 2 percent salt added; Brood 2, shelled corn, soybean oilmeal with 2 percent salt added, and steamed bonemeal. When the pullets were mature they were transferred to laying houses and fed grain and mash during the laying year. Though in egg production and hatchability of eggs there were differences between the two broods, the differences were not conclusive.

Sorghum sirup.— Untreated plots in a fertilizer test produced an average yield of 552 pounds of 80-percent sirup per acre. The plot fertilized with 200 pounds of nitrate of soda and 400 pounds of 20-percent superphosphate per acre produced at the rate of 815 pounds of sirup per acre. Another plot fertilized with 50 pounds of muriate of potash in addition to nitrate of soda and superphosphate produced at the rate of 1,063 pounds of sirup; and the companion plot that was limed at the beginning of the experiment produced at the rate of 1,560 pounds. In the variety test, Williams produced at the rate of 1,440 pounds of sirup per acre; Justice, 1,160 pounds; and Blue Ribbon from West Kentucky, 690 pounds.

Mine props from Robinson Forest.— Sale of mine props during the year amounted to $215.60, an average of $15.62 per cord on the estimated cordage. Highest return was $22.25 per cord for special peeled oak jacks. Hauling cost, amounting to 31.6 percent of the returns, was too high, but it was necessary to pay a premium in order to have the timber moved at all.

At the forest this year 12 fires were reported, and a total of 77 acres was burned. This was about 0.6 percent of the forest area.

NEW PROJECTS — 1945

Hotbed heating by electricity.

The effect of nitrogen-potassium relationships in potato tissues on yields.

Dried wheat distillers' solubles as a protein supplement for growing fattening pigs in drylot and on pasture.

The value of distillers' dried solubles as a protein supplement for growing fattening hogs.

The use of distillers' dried solubles in calf rations.

The relative feeding values of alfalfa hays cured in the field and on the forced-air barn hay drier.

Improvement of meat characters in the chicken.

The thiamine and riboflavin content of turkey cooked by institution methods.

A study of land use potentialities and effective farm management systems in selected representative agricultural areas in Kentucky.

A study of farm values and trends.

An economic study of farm equipment.

Price policy as a factor in adjustment of supply of milk to meet market requirements.

PUBLICATIONS

BULLETINS

471. Rutelinae of Eastern North America with descriptions of the larvae of *Strigodermella pygmaea* (Fab.) and three species of the tribe Rutelini (Coleoptera: Scarabaeidae). P. O. Ritcher, January, 1945.

472. Life history of the wireworm *Conoderus bellus* (Say). H. H. Jewett. May, 1945.

473. Composition and yield of Kentucky bluegrass and Korean lespedeza at different stages of growth. G. Davis Buckner and Amanda H. Henry. June, 1945.

474. Tobacco auction markets in Kentucky. C. M. Clark and H. B. Price. June, 1945.

475. Labor supply and farm production on Eastern Kentucky farms. John H. Bondurant and W. D. Nicholls. June, 1945.

476. North American Cetoniinae with descriptions of larvae and keys to genera and species (Coleoptera: Scarabaeidae). June, 1945.

477. Coprinae of Eastern North America with descriptions of larvae and keys to genera and species (Coleoptera: Scarabaeidae). P. O. Ritcher. June, 1945.

478. Rural people in the city. Howard W. Beers and Catherine Heflin. July, 1945.

479. Collection of milk and cream from farms in Kentucky. C. D. Phillips. August, 1945.

480. Feed for Kentucky livestock. Amounts of livestock and feed produced, and sources of purchased feed. John B. Roberts. October, 1945.

REGULATORY SERIES BULLETINS

42. Commercial fertilizers in Kentucky in 1944. J. D. Turner, H. R. Allen and Lelah Gault. June, 1945.

43. Commercial feeds in Kentucky in 1944. J. D. Turner, Stacy B. Randle, W. G. Terrell, and J. J. Rose. July, 1945.

44. Some items of interest to Kentucky nurserymen for the year ended June 30, 1945. W. A. Price and Howard G. Tilson. July, 1945.

45. Seed inspection in Kentucky 1944-45. W. A. Price, Mary L. Didlake, E. C. Vaughn, Encil Deen, Howard Tilson, Alice McDaniel, Margaret Morton, Mary Lee Littell, Lucy Baugh, and Charlotte Cundiff. October, 1945.

9. Testing cream and milk for butterfat. Reprinted. J. D. Foster. July, 1945.

EXPERIMENT STATION CIRCULARS

57. Pregnancy disease of ewes. Causes, symptoms, treament and prevention. F. E. Hull. January, 1945.

58. Hog cholera. Suggestions on prevention and difficulties of diagnosis. W. W. Dimock. January, 1945.

59. Literature of the black carpenter ant. *Camponotus herculeanus pennsylvanicus (Degeer.)* A bibliography with abstracts. Lee H. Townsend. March, 1945.

ANNUAL REPORT

Fifty-seventh annual report of the Experiment Station (for 1944). Thomas P. Cooper.

MISCELLANEOUS

Kentucky Fruit Notes, issued quarterly (January, May, August, and November). W. D. Armstrong, editor.

SCIENTIFIC PAPERS

In Agronomy

Apparatus for the rapid determination of chlorophyll and carotene. R. B. Griffith and R. N. Jeffrey. Indus. and Engin. Chem. Analyt. Ed. 17 : 448-51. 1945.

Effectiveness of fused phosphate of different particle size. G. L. Terman. Soil Sci. Soc. Amer. Proc. 9 : 154-158. 1945.

Excretion of nitrogen compounds by some legumes grown in sand cultures. Hugh G. Myers and P. E. Karraker. Amer. Soc. Agron. Jour. 37 : 81-89, 1945.

In Animal Husbandry and Dairying

Abnormal appetites of laying hens in feeding experiments. G. Davis Buckner, W. M. Insko, Jr., and Amanda Henry. Poultry Sci. 24 (2): 120. March, 1945.

A comparison of fats in laying pullets and yearling hens. G. Davis Buckner, W. M. Insko. Jr., and Amanda H. Henry. Poultry Sci. 24 (2): 126. March, 1945.

Distillery slops for fattening steers. W. H. Black, N. R. Ellis, and W. P. Garrigus. Jour. Anim. Sci. 4 (2): 158-163. May, 1945.

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Form variation in group C Salmonella strains. P. R. Edwards. Soc. Expt. Biol. and Med. Proc. 59 : 49-52, 1945.

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Ashing procedures for the determination of copper in plant material. L. F. Bailey and J. S. McHargue. Plant Physiol. 20 (1): 79-85. 1945.

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Report on acid- and base-forming quality of fertilizers. H. R. Allen and Lelah Gault. Assoc. Off. Agr. Chem. Jour. 28 : 778-781, November, 1945.

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Ontology of consciousness. Lester S. O'Bannon. Ky. Acad. Sci. Trans. 11: 41-46, 1945.

FINANCIAL STATEMENT

Receipts and expenditures under Hatch, Adams, Purnell, and Bankhead-Jones Acts, and the State Offset Required by the Bankhead-Jones Act.

Fiscal year ended June 30, 1945

	Hatch	*Adams*	*Purnell*	*Bankhead-Jones*	*Bankhead-Jones Offset*
Receipts					
From the Treasurer of the United States as per appropriations for fiscal year ending June 30, 1945	$15,000.00	$15,000.00	$60,000.00	$81,533.32	
Receipts from sources within the state as Bankhead-Jones offset					$81,533.32
Expenditures					
Personal Services:					
Administration	2,900.00				
For all other purposes	11,180.00	14,329.22	55,624.64	75,358.00	
Travel	162.52		1,780.20	469.38	
Transportation of Things	20.61	10.88	13.60	24.12	
Communication Service	67.87		38.48	2.22	
Rents and Utility Services:					
Rent of space in buildings or equipment					
Printing and Binding:					
Printing publications	387.00		400.25	904.98	
Other printing and binding			354.00	486.90	
Other Contractual Services:					
Repairs and alterations to equipment, and other contractual services not otherwise classified		10.00	581.20	188.98	
Supplies and materials	282.00	614.90	787.51	3,253.53	
Equipment		35.00	420.12	845.21	
TOTAL EXPENDITURES	15,000.00	15,000.00	60,000.00	81,533.32	
Unexpended balances June 30, 1945	.00	.00	.00	.00	
BANKHEAD-JONES OFFSET, TOTAL APPROVED EXPENDITURES					$81,533.32

We, the undersigned, certify that the receipts and expenditures shown in this report from Federal funds and as offset to Bandhead-Jones funds are correct; that the expenditures were solely for the purposes set forth in the acts of Congress approved March 2, 1887 (Hatch), March 16, 1906 (Adams), February 24, 1925 (Purnell), May 16, 1928 (Hawaii), February 23, 1929 (Alaska), March 4, 1931 (Puerto Rico), June 29, 1935 (Bankhead-Jones Title I), June 20, 1936 (Alaska) and March 4, 1940 (Employer Contributions to Retirement); that the expenditures are in accordance with the terms of said acts so far as applicable to this station; and that properly approved vouchers are on file for all expenditures.

Signed:

THOMAS COOPER
Director of Experiment Station

FRANK D. PETERSON
Comptroller

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Agricultural Experiment Station

of the

University of Kentucky

FIFTY-SEVENTH ANNUAL REPORT

IMPERIAL MYCOLOGICAL
28 JUL 1945
INSTITUTE

Report of the Director
for the year 1944

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---

[1] Resigned April, 1944
[2] Resigned May 31, 1944
[3] In military service
[4] Resigned September 27, 1944
[5] Resigned January 31, 1944
[6] Resigned April 10, 1944
[7] Resigned July 24, 1944
[8] Emeritus, July 1, 1944
[9] Resigned August 15, 1944
[10] Resigned October 31, 1944
[11] Transferred temporarily to College of Arts and Sciences